BEFORE YOU BEGIN…

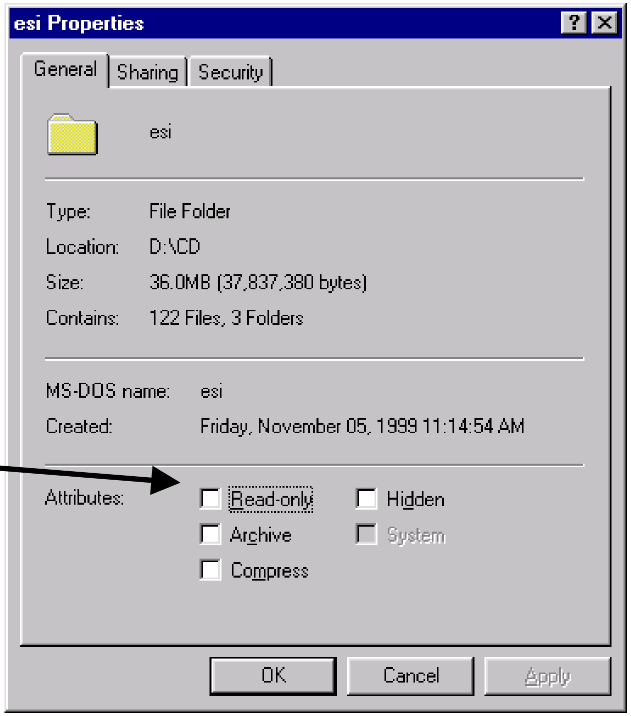
Before beginning these training exercises, you need to copy some folders to your hard drive.

Using your file manager, navigate to the CDROM drive. Once there, you will see several directories which include a "**training**" and "**esi**" folder that you will need to copy to your hard drive.

Highlight the two folders by holding the shift key and using the left mouse button to click on the two folders. Drag the highlighted folders to your hard drive. You should now see the **esi** and **training** folders on your hard drive. *Note: the exercise instructions that you will be following in this training manual are written under the assumption that your hard drive letter is* ***c:/***.

Once you have copied these files, you need to remove the "**read-only**" protection placed on them. Go into each directory and highlight all the files and folders by holding the shift key and using the left mouse button to click on them. Once they are selected, use the right mouse button to click anywhere on the list. From the dialog box that appears, select **Properties**.

You will now see the graphic shown on the right. Remove the check from the box marked **Read-only** to disable this option for the selected files. Click **Apply** when done.



Open **ArcView** 

and begin by turning to Exercise 1.

1. Examining water quality and land use

Exercise 1A	Examine Ipswich River water quality sampling
Exercise 1B	Evaluate surrounding land use
Skills	• Import Excel tables • Perform theme queries • Create shapefiles • View MrSID aerial photos • Buffer • Clip • Use ESRI scripts • Load preset legends • Perform statistics

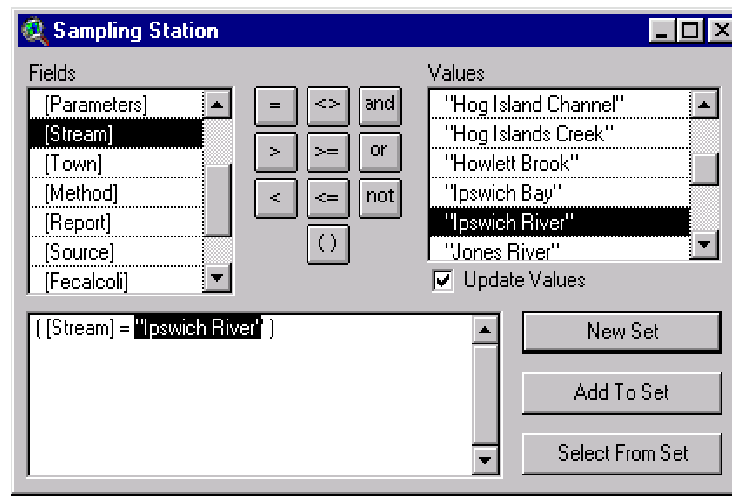
Estimated Length: 60 minutes

Exercise 1A. Examine Ipswich River water quality sampling

In this exercise, we will examine data collected from water quality sampling stations in the Ipswich River. Results from these types of studies can help users evaluate sources and develop strategies to reduce nonpoint source pollution from surrounding landscapes.

Begin by opening the Water Quality project using the path **c:\training\wq\water_quality.apr**. The open view shows water quality sampling stations located in Great Marsh watersheds on the North Shore of Massachusetts. The **Sampling station** theme legend shows who is collecting the samples. Make sure the **Sampling station** theme is **Active** before moving on.

Since we will be examining water quality in the Ipswich River, open the **Query Builder**. 



Create the expression shown on the right by scrolling down the **Fields** menu and double-clicking on **Stream**. Click once on "=" and double click on **Ipswich River** from the **Values** menu.

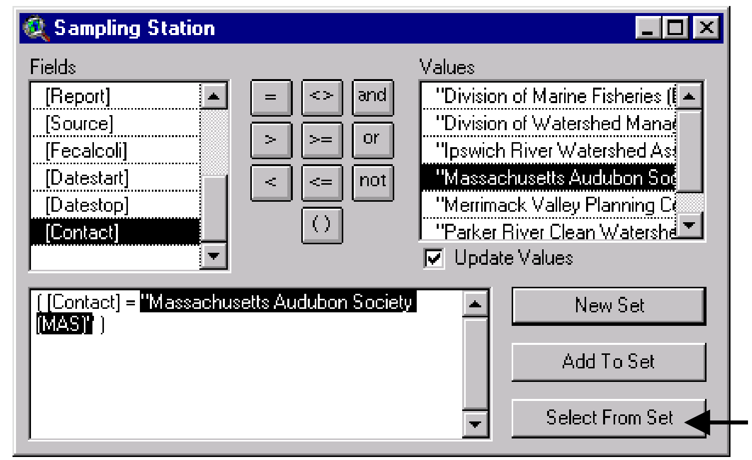
Choose **New Set** and close the Query Builder.

*Note: if you have problems creating the expression and get a "**syntex error**" message, close your existing query builder and open a new one to create the expression again.*

Notice that sampling stations in the Ipswich River are now selected. Click the **Zoom to Selected**  button to focus your view on the river.

Let's begin looking at water quality data collected in the Ipswich River by the Massachusetts Audubon Society. Minimize ArcView, open the program **Excel**, and open the **sampling.xls** file from **c:/training/wq directory**.

Note that most stations have fecal coliform counts over 200. When high concentrations of fecal coliform are reached in a body of water, certain uses are prohibited. Swimming is banned above 200 fecal coliforms per 100 ml of water. Since shellfish concentrate pathogens, the limit for shellfishing is 14/ml. Any measurable level of fecal coliform in drinking water is considered unsafe. Later in this exercise, we will select stations where fecal coliform levels are above 200/ml



Minimize Excel and go back into ArcView. Perform another query on the still active **Sampling station** theme. Create the expression shown on the right.

Click **Select From Set** to select only Massachusetts Audubon stations in the Ipswich River. **Close** the query builder.

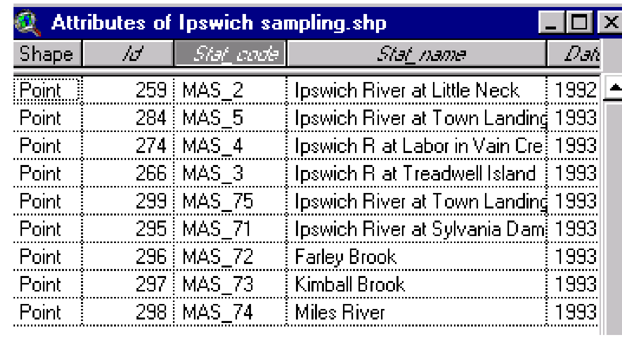
Zoom to Selected  to focus more closely on the Mass Audubon stations. Since we will be looking at these stations for the rest of the exercise, we will create a shapefile (or a new theme) of these selected stations.

To create this new shapefile, go to the **Theme** pull down menu and choose **Convert to Shapefile**. Name the theme **Ipswich_sampling** and save it in the **c:/training/wq** directory. **Add** the shapefile to your view.

Turn off the **Sampling Station** theme and turn on the **Ipswich Sampling** theme. We will now join our Excel data to this theme's attribute table.

Note: Join can be performed since there is a one to one relationship. ***Link*** *is used when there is a one to many relationship. We will discuss these operations more in class.*

Make the **Ipswich Sampling** theme **active** and open its attribute table. Note that the sampling stations fall in a field labeled **Stat_code**.



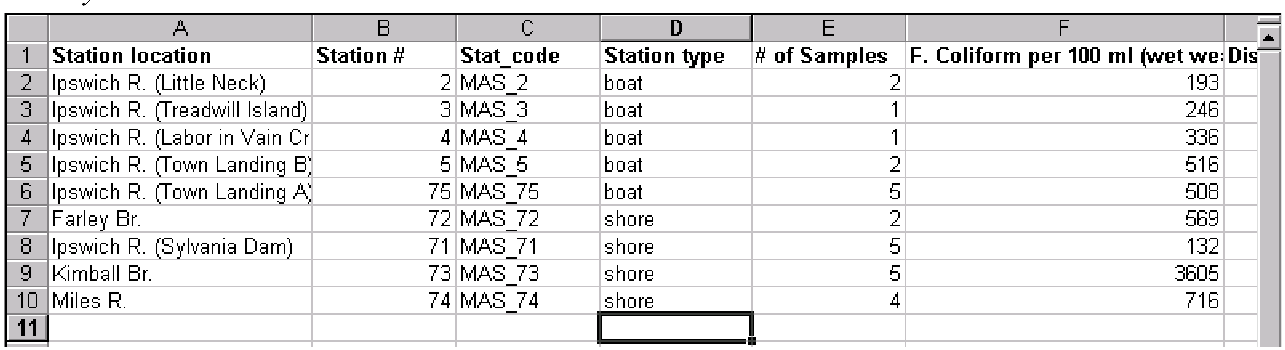
Attributes of Ipswich sampling.shp

Shape	Id	Stat_code	Stat_name	Dat
Point	259	MAS_2	Ipswich River at Little Neck	1992
Point	284	MAS_5	Ipswich River at Town Landing	1993
Point	274	MAS_4	Ipswich R at Labor in Vain Cre	1993
Point	266	MAS_3	Ipswich R at Treadwell Island	1993
Point	299	MAS_75	Ipswich River at Town Landing	1993
Point	295	MAS_71	Ipswich River at Sylvania Dam	1993
Point	296	MAS_72	Farley Brook	1993
Point	297	MAS_73	Kimball Brook	1993
Point	298	MAS_74	Miles River	1993

To join the Excel data to this table, we need to create a column with these station codes within the Excel spreadsheet.

Create a Stat_code column in Excel by clicking and highlighting the column "**C**" header. Choose "**Columns**" from the **Insert** menu. In the first row of this column, enter **Stat_code** as the header. In rows 2 to 10 enter the corresponding codes that appear in the ArcView table (i.e, for station 2 in Excel, enter the corresponding ArcView station code of MAS_2…be sure to use all **capital** letters since joining tables in ArcView is case sensitive).

Note:when you are done entering the stat_code values, make sure you click outside the last cell where you entered data or only this selected cell will be saved.



	A	B	C	D	E	F	
1	Station location	Station #	Stat_code	Station type	# of Samples	F. Coliform per 100 ml (wet we	Dis
2	Ipswich R. (Little Neck)	2	MAS_2	boat	2	193	
3	Ipswich R. (Treadwill Island)	3	MAS_3	boat	1	246	
4	Ipswich R. (Labor in Vain Cr	4	MAS_4	boat	1	336	
5	Ipswich R. (Town Landing B)	5	MAS_5	boat	2	516	
6	Ipswich R. (Town Landing A)	75	MAS_75	boat	5	508	
7	Farley Br.	72	MAS_72	shore	2	569	
8	Ipswich R. (Sylvania Dam)	71	MAS_71	shore	5	132	
9	Kimball Br.	73	MAS_73	shore	5	3605	
10	Miles R.	74	MAS_74	shore	4	716	
11							

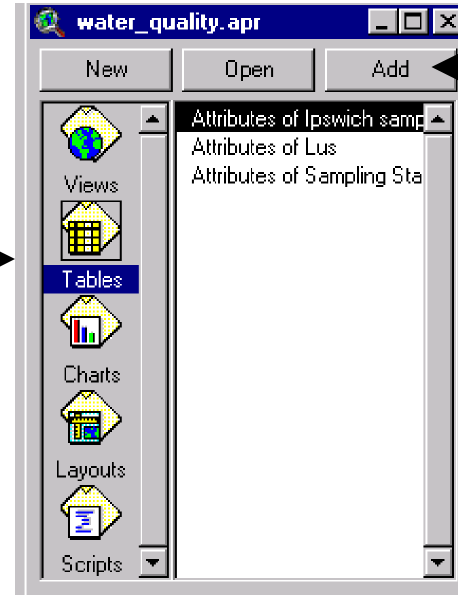
Since ArcView will only join tables in DBF format, choose **Save As**, and save this table as a **DBF4** file with the same name to the c:/training/wq directory.

Click OK in the warning box that appears (since we are not saving multiple sheets).

We will now combine the data from this DBF file with the sampling stations table in ArcView.

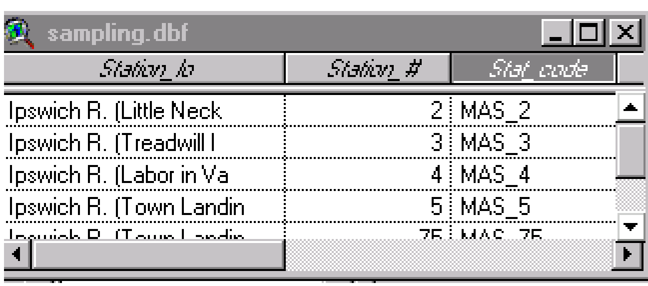
Minimize **Excel** and go back into **ArcView**.

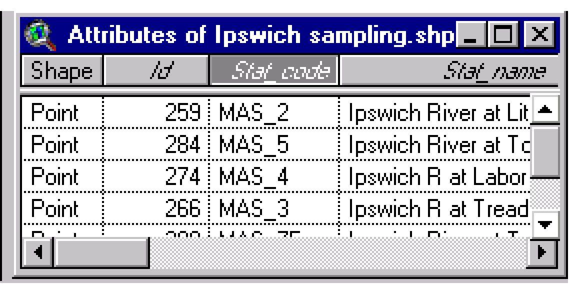
With our **Sampling station** table still open in ArcView (you can reduce its window size by clicking and dragging the upper right corner), we will now add the Excel **Sampling.dbf** table to the project. Click the **Project** window to make it active and then make the **Tables** document active.



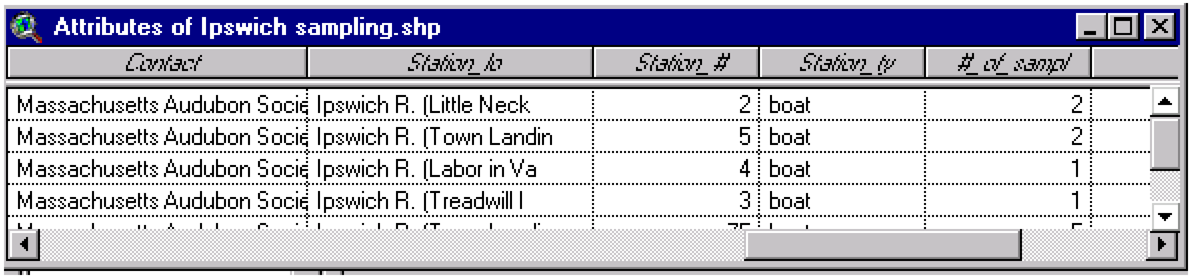
Click the **Add** button. In the Add Table dialog box, navigate to the **c:/training/wq** directory and double-click on the **Sampling.dbf** file.

With this new table active, click the **Stat_code** field to highlight it. Now make the **Ipswich sampling** station table active and click on its **Stat_code** field to highlight it.



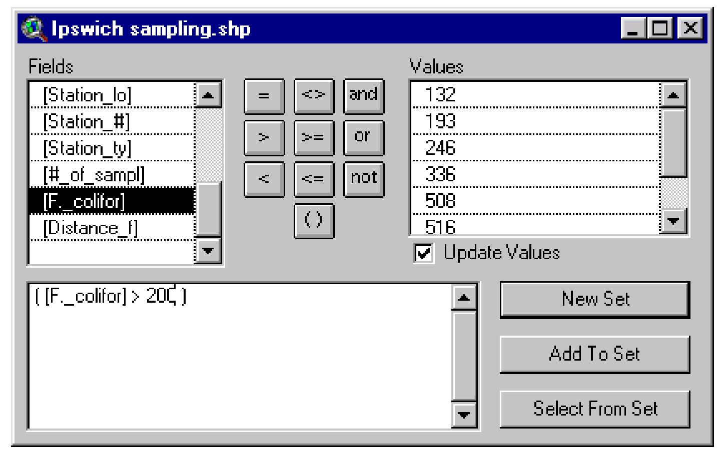


With the **Ipswich sampling** table still active, select **Join** from the **Table** menu. Notice the Excel table disappeared from your screen. Scroll across the **Ipswich sampling** table to see the Excel table records have been appended to the right.

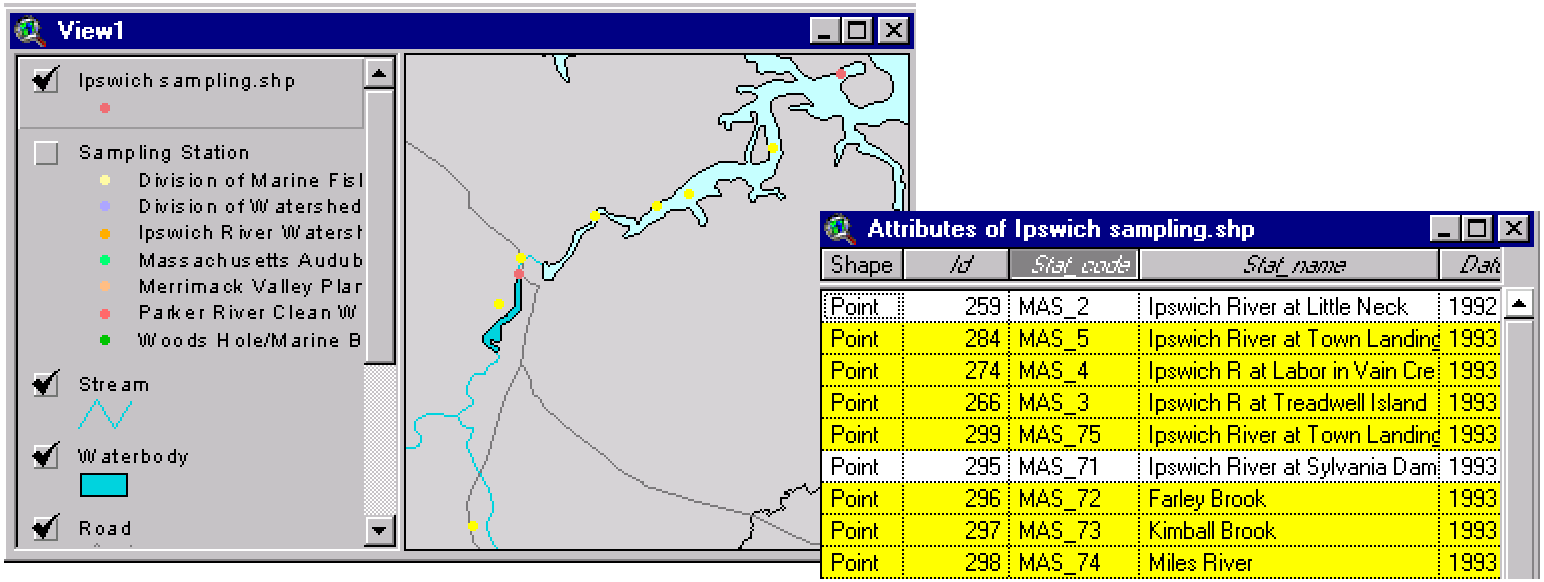


We can now perform queries on the new records in the table. For example, to find stations where fecal coliform counts are over 200 per ml, click on the query button. 

Select the newly joined field **F_coliform**, choose the ">" symbol, and type **200**.



Click **New Set** and close the query builder. Notice records in the table highlight and the corresponding points in the view are selected where fecal coliform was sampled to be greater than 200 per ml.



Close the **Ipswich Sampling** table and turn off the **Water body** and **Stream** themes before moving on.

This exercise demonstrates a way to identify areas with high bacterial levels and prioritize sites to begin addressing nonpoint source pollution. In the next exercise, we will look at surrounding land use on this segment of the Ipswich River to see what might be possible sources of pollution.

Exercise 1B. Evaluate surrounding land use

Since aerial photography is often useful in geographic analysis, this exercise begins by introducing a powerful ArcView Extension to view large raster-based image files.

From the **File** pull-down menu, open the **Extensions** dialog box. Check the **MrSID Image Support** option. MrSID is a powerful image compressor, viewer, and file format for large, high resolution images like aerial photos. With MrSID, you can quickly view and manipulate these files because it selectively decompresses on the part of the image you are interested in viewing. *Note: the MrSID extension is only available in versions of ArcView 3.1 or higher*.

Using the **Add themes** button,  navigate to the **c:/training/wq directory**. Make sure the **Data Source Type** is set to **Image Data Source**. Add the **i_2.sid** image to the project. (*Note: all images of the Great Marsh are located in the Half-meter_OQ directory on the CDROM. Letters such as **i, e, g** stand for town names Ipswich, Essex, Gloucester, etc*).

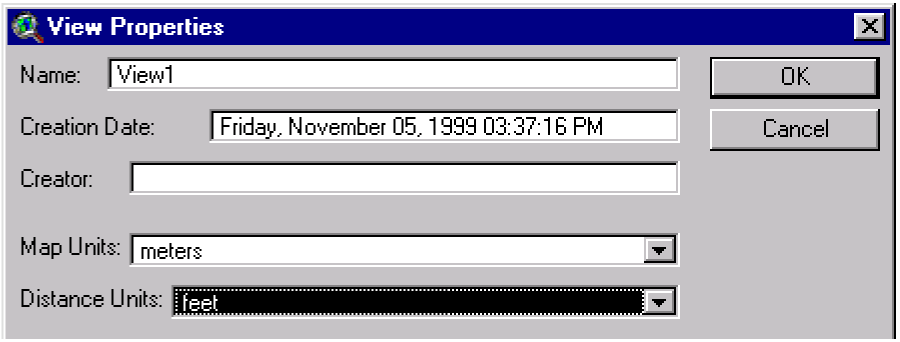
When it appears in your **Table of Contents**, drag the image below the **Land use** theme and turn it on.

Both the Plum Island Sound Minibays project and the Ipswich Coastal Pollution Control Committee found that water flowing between the Sylvania Dam and the town landing through downtown Ipswich receives major inputs of bacteria. Beyond the town landing, bacterial concentrations gradually decline. For purposes of this investigation, the segment of the Ipswich River from the dam to the landing has already been made into a shapefile. Since studies indicate that stormwater runoff is one contributor of fecal coliform to the Ipswich River, we will begin looking at land use in the area.

Turn on **Land Use** and **River Segment**. To view the Land Use legend, make the theme **active** and go the the **Theme** menu to select **Hide/Show Legend**. *(NOTE: this is a useful way to hide large legends when you're not viewing a theme).*

Observe the different types of land use in the region. To view land more closely around the area of this study, make the **River segment** theme active and click the **Zoom to Active Theme** button.  See how well the Land Use theme codes correspond with the aerial photo basemap. Where there are land use types that don't match up correctly with the photo image, it's important to consider the scale differences of the two themes (i.e, land use is at a scale of 1:25,000 where the photo resolution is half meter or close to 1:5,000).

For the purposes of this exercise, we will be interested in calculating land use types in the buffer area defined by the Rivers Protection Act. In these regulations, the riverfront area is defined as extending 200 ft. from mean annual high water. To create a 200 foot buffer on each side of the river segment we are looking at, we first need to set the View's **Distance Units** to feet.



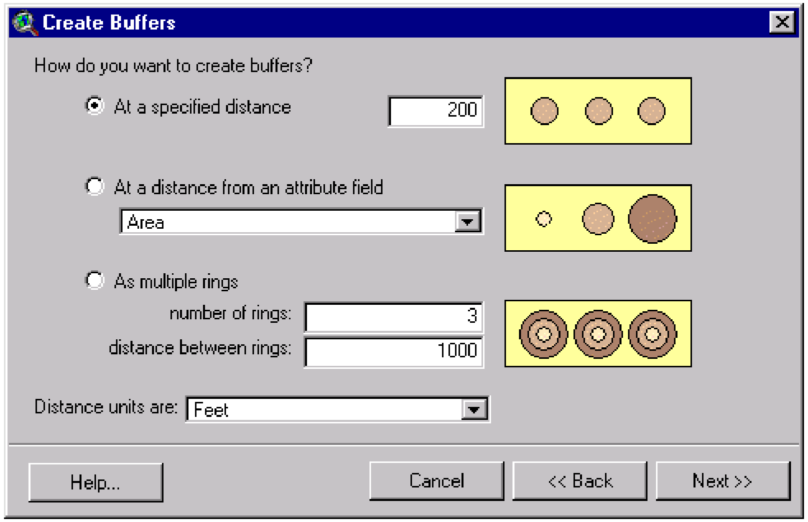
From the **View** pull down menu, select **Properties**. The map units are already been set to meters (the projection units of MassGIS data), but you need to change the **Distance Units** to **feet**.

Click **OK**.

Make sure the **River Segment** theme is **active**.

Now we can begin buffering!
(Note: ArcView will not let you buffer until you set the Distance Units)

From the **Theme** menu, select **Create Buffers**. In the dialog box that appears, make sure that **River_segment** is the chosen theme to buffer and click **Next**.



In the next dialog box that appears, click the first option for buffering "**at a specified distance**". Change the value by typing in **200**.

Remember since we changed distance units to be feet, this value of 200 is indicated here to be in feet.

Click **Next** to move on.

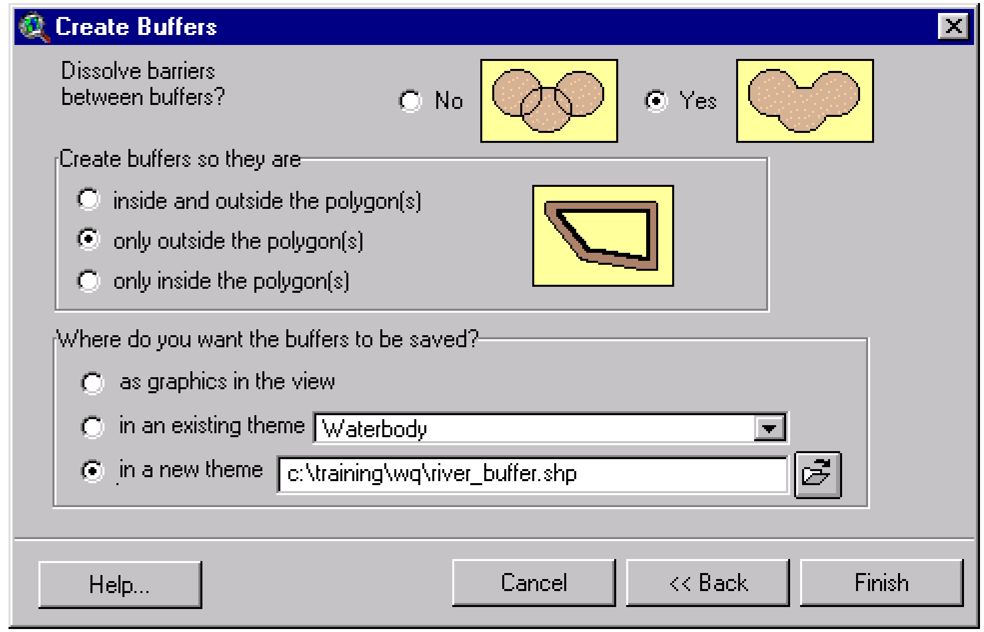
In the dialog box that appears next, there are three steps.

First, make sure that **Yes** is checked for the "**Dissolve Barriers between buffers**".

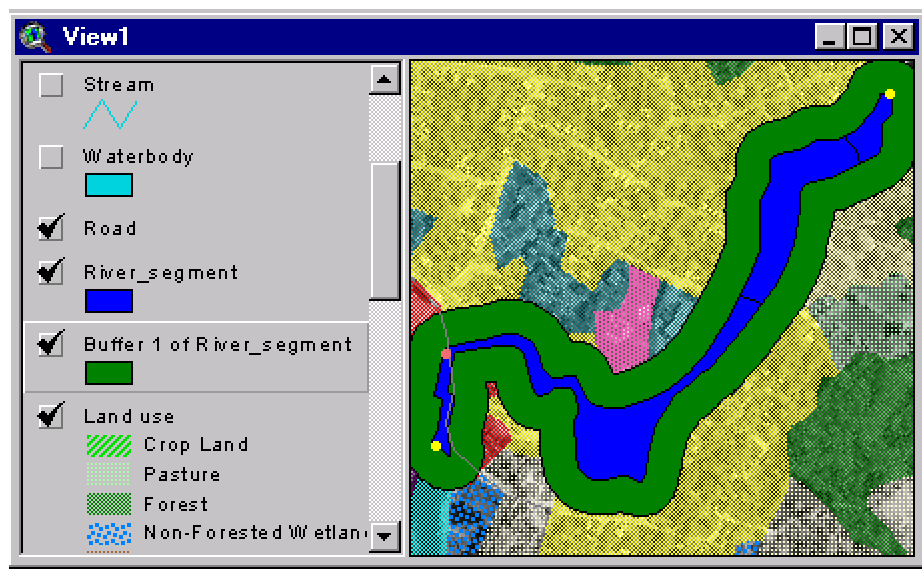
Second, select the choice "**only outside the polygons**".

Third, save "**in a new theme**" by creating the theme **river_buffer.shp** and saving it to the c:/training/wq directory.

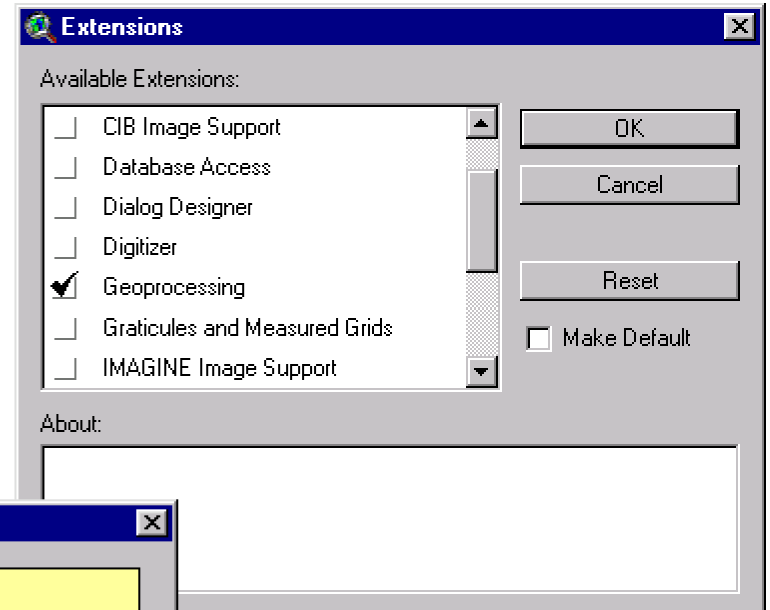
Click **Finish** and watch as ArcView creates the new buffer!



Move the new theme **River_buffer** below the **River_segment** theme in your table of contents to view how it looks.

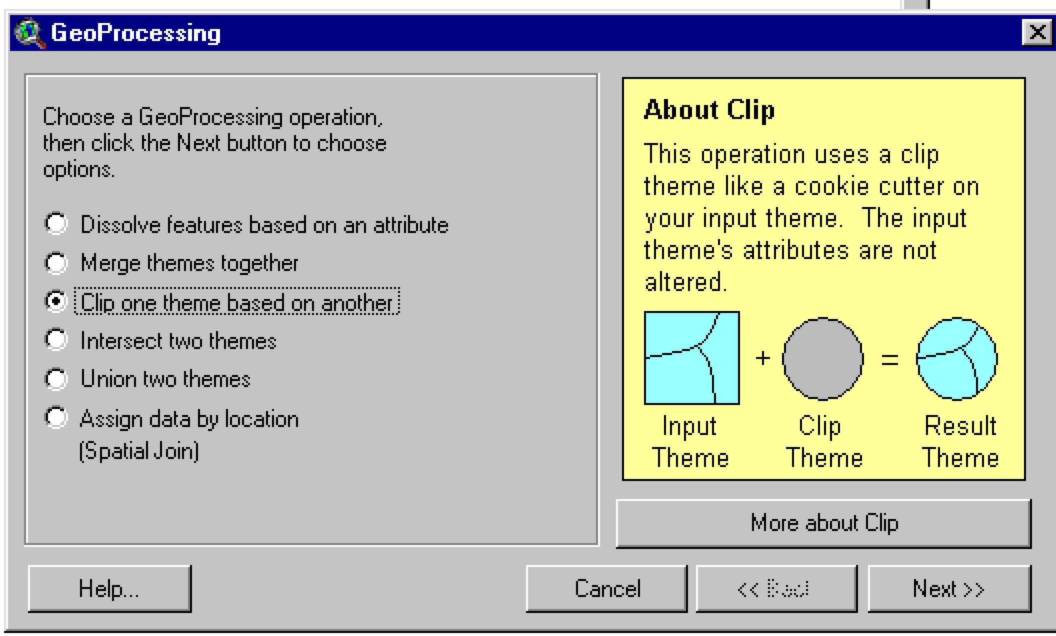


To calculate land use types within this buffer, we need to clip the **Land Use** theme to the buffer boundaries. From the **File** menu, choose **Extensions**. The list of choices that appears gives options for adding extensions to your ArcView project. Scroll down this list to get an idea of other extension choices you might have for future work.



Select the option **Geoprocessing** which will be needed to begin clipping and click **OK**.

From the **View** pull down menu, select **GeoProcessing Wizard**.



In the GeoProcessing dialog box, note the options available to you. This tool can be used to perform many different types of operations on a theme.

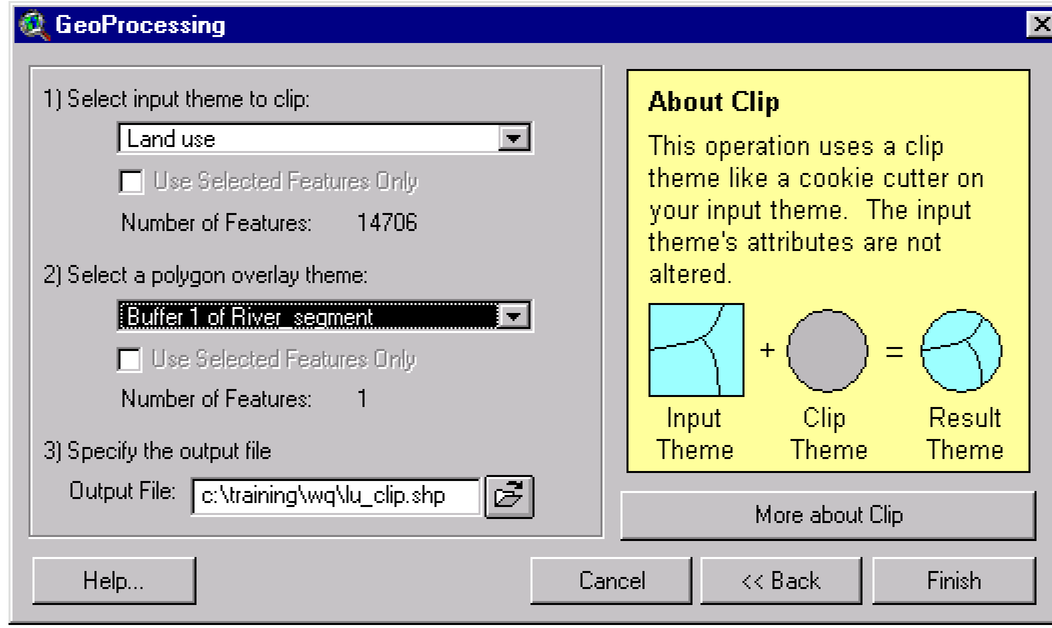
Select the choice "**Clip one theme base on another**". Choose **Next**.

1) From the input theme list, select **Land Use**. This is the Input Theme.

2) From the polygon theme overlay list, select **Buffer 1 of River Segment**. This is the Clip Theme.

3) Click on the browse folder to save output file to **c:\training\wq**\. Name the new theme **Lu_clip.shp**.

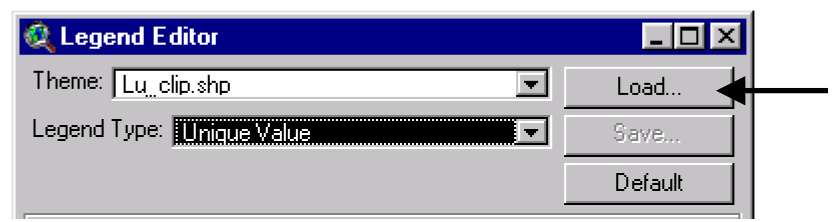
Click **Finish** to begin the clipping process.



Drag this clip theme above the **Buffer1 of River Segment** theme and turn it on. Notice that the land use polygons are all one solid fill color. To load in the Land Use theme's legend which shows different land use classes, go into the **Legend Editor** by double clicking on the **Lu_clip.shp** theme.

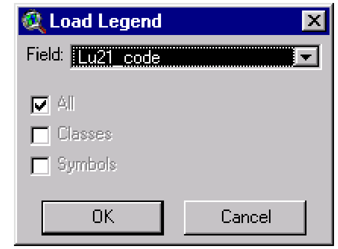
Select **Legend Type** to be **Unique Value**.

To load in a preset legend from MassGIS, click the **Load** button.



Navigate to the **c:\training\wq\land use** directory to find two **.avl** legend files that have been created by MassGIS for the land use coverage. The first, **lu1211p.avl** is a legend with solid fill. The second is **lu1212p.avl** is a transparent fill. For the purposes of this exercise, choose **lu1211p.avl** as the solid fill legend. *NOTE: when creating your own projects, you can save any legends you have made as .avl files. These preset legends can be loaded and used in new projects to prevent you from having to create a new legend each time.*

To load this legend properly into the Lu_clip theme, we need to select a field to be represented in the new legend. Choose **Lu_21code** and click **OK**.



Notice how the **Legend Editor** changes to represent land use types.

Click **Apply** and **Close** the Legend Editor.

IMPORTANT. O*ne ArcView limitation is that new themes clipped using the GeoProcessing Wizard will not have an updated area and perimeter field. For example, polygons along the buffer's border have been cut to a smaller size during the clipping process. Thus, the area and perimeter fields for the resulting land use clip theme will have values larger than they should be for polygons that were clipped along the buffer's edge. Since the area and perimeter of the clipped coverage should be smaller, we need to recalculate these values by using an ESRI script.*

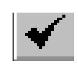
NOTE IF YOU ARE INTERESTED IN USING A SHORT CUT IN THE MASSGIS DATAVIEWER TO PERFORM THESE TASKS, CLOSE YOUR PROJECT AND MOVE ONTO EXERCISE 2.

To reduce confusion between the two themes, turn off the original **Land Use** theme before moving on.

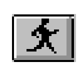
From the **Project** window, click on the **Scripts** document. Click **New** to add the script.

From the **Script** pull down menu, select **Load Text File**.

Navigate to **c:\esri\av-gis30\arcview\sample\scripts** and locate the **calcapl.ave** file which will be used to update area and perimeter. Click **OK**.

The first step in adding a new script is to choose the **Compile** button. 

The second step is to go back to the **View** and click on the **Lu_clip** theme to make sure it's active. *NOTE: a script will not run if you do not click on the active theme to be updated (even if it already appears to be active in the Table of Contents).*

The third step is to make the **Script** active again and click the **Run** button. 

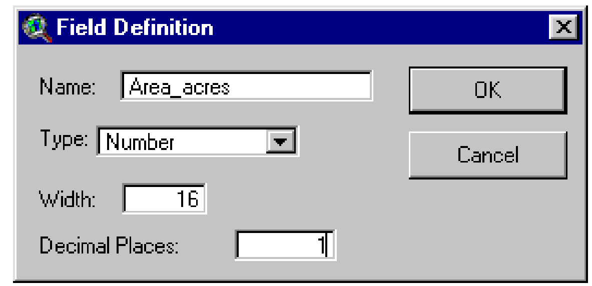
Click **Yes** when asked if you want to Update the Area and Perimeter.

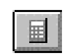
Open the **Lu_clip** table  and view how the area and perimeter field values have become smaller.

Since we are trying to calculate areas of different land use types, it is more useful to express the field "area" in acres rather than the existing units of "m^2". To convert meters to acres, we will add a new field and use the table calculator.

With the **Lu_clip** table still open, choose **Start Editing** from the **Table** menu.

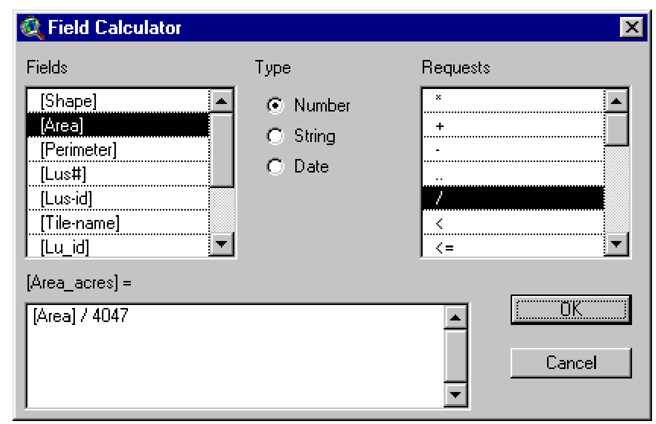
From the **Edit** menu, choose **Add Field**. In the dialog box that appears, name the new field **Area_acres** and choose 1 as the number of decimal places. Click **OK**. Notice that the new field Area_acres has been added to the right side of the table.



To convert m^2 to acres, click the **Field Calculator** button. 

From the **Fields** menu, double click on **Area**. Then double click on the divide symbol "/" from the **Requests** list.

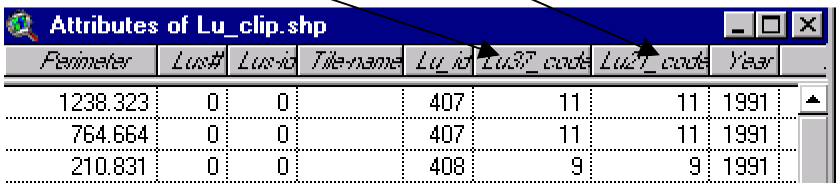
Since 1 acre = 4047 m^2, type the value **4047** to complete the expression shown on the right. *Note: the field name selected at the top of the active table will automatically be used as the first part of the mathematical expression.*



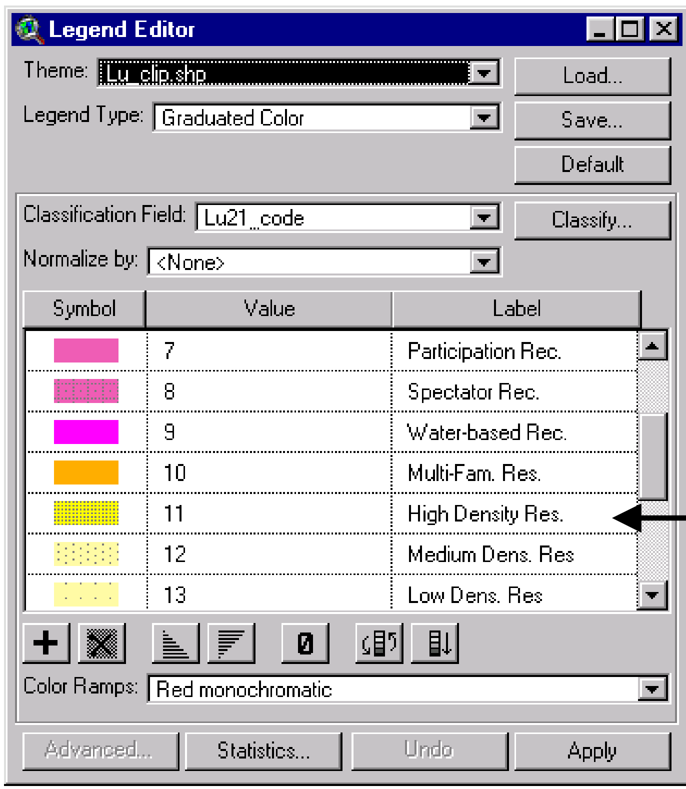
Click **OK**. Notice the table now has a field with acres for the new area.

From the **Table** menu, chose **Stop Editing** and **Save** the edits.

Now we want to calculate the area for one type of land use in the buffer zone (in this case, "High Density Residential"). However, while still in the Lu_clip table, notice that there is not a field describing the different land use types. Instead, the fields Lu37_code and Lu21_code give values for each type of land use.



To figure out what these values stand for, close the table and open the **Lu_clip** theme's **Legend Editor** by double clicking on it in the **Table of Contents**.



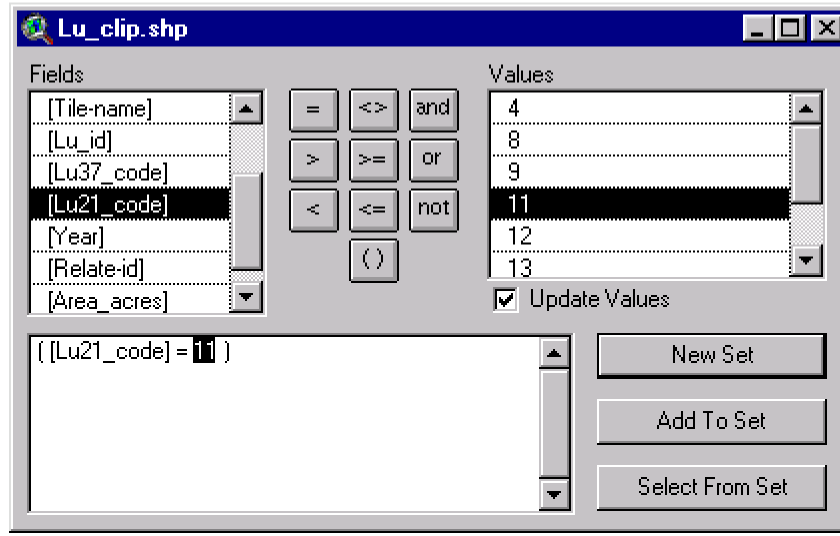
Scroll down the table and find the value associated with the **High Density Res.** label. The value for this label is "**11**". (Remember this is the MassGIS pre-set legend we loaded).

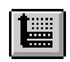
We will select only the high residential polygons by doing another theme query. **Close** the **Legend Editor** and go back to your view.

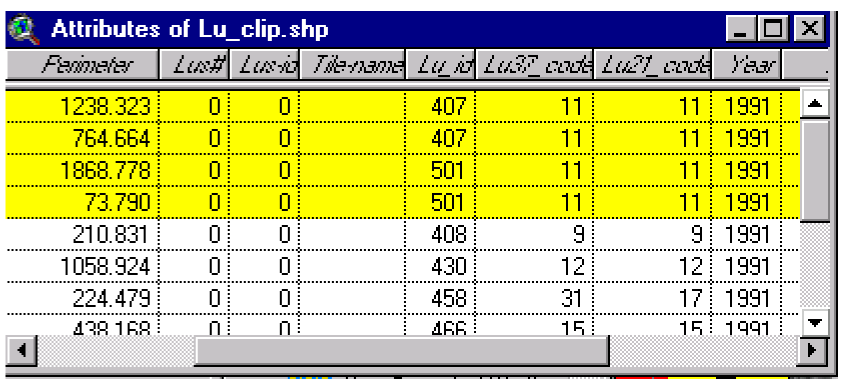
With the **Lu_clip** theme still active, click on the query button. 

Select the Field **Lu21_code** with a value of **11** (representing high residential development) to form the query statement shown here.

Click **New Set** and close the Query Builder.



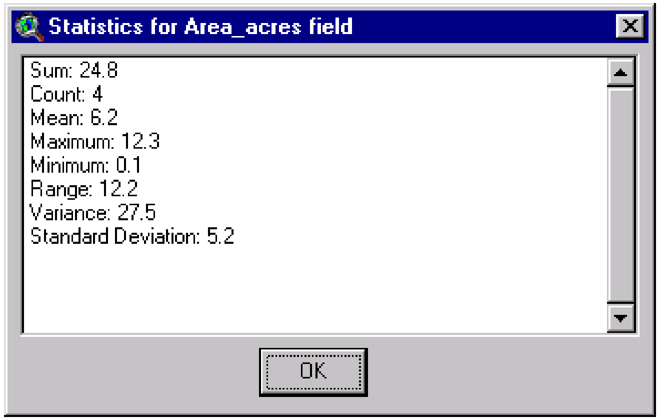
Open the Lu_clip table and click the **Promote**  button to bring the selected records to the top of the table. (Notice there are 4 polygons in the buffer defined as high residential development with the code = 11).


Attributes of Lu_clip.shp

Perimeter	Lus#	Lus-id	Tile-name	Lu_id	Lu37_code	Lu21_code	Year
1238.323	0	0		407	11	11	1991
764.664	0	0		407	11	11	1991
1868.778	0	0		501	11	11	1991
73.790	0	0		501	11	11	1991
210.831	0	0		408	9	9	1991
1058.924	0	0		430	12	12	1991
224.479	0	0		458	31	17	1991
438.168	0	0		466	15	15	1991

To find the total area of high residential land use selected, choose **Statistics** from the **Field** pull down menu. The **SUM** shows that there are 24.8 acres of high residential land use in the 200 foot buffer adjacent to our selected segment of the Ipswich River.

If you want to determine the area other land use types within this buffer, you could go through the same steps of doing a query to select a different land use code and choosing statistics to summarize the selected records.



This exercise has shown how to target a river segment with poor water quality and calculate different types of land use to help identify possible sources of pollution. Methods of buffering, clipping, theme queries, creating shapefiles, and calculating statistics can now be used as applications in future work.

IMPORTANT. If you have access to the MassGIS dataviewer, the next exercise will show you how to summarize land use statistics much faster than this exercise has demonstrated. Go on to Exercise 2 if you have the dataviewer already loaded on your machine. If you do not, skip to Exercise 3.

END

2. Calculating Land Use and Pollutant Loading Statistics

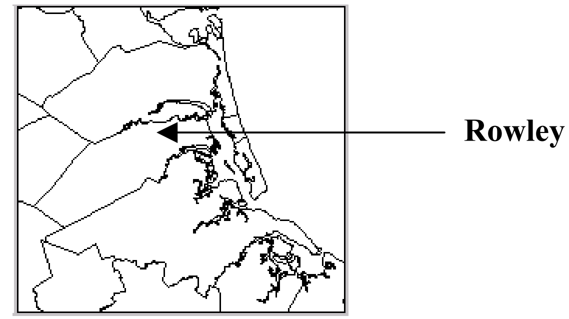
Exercise 2	Land use and pollution estimates
Skills	• Load preset legend • Use the MassGIS Data Viewer • Use land use and pollutant loading tools • Generate reports

Note: you need to have the MassGIS dataviewer loaded on your machine to run this exercise.

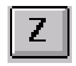
Estimated Length: 20 minutes

Exercise 2. Land use and pollution estimates

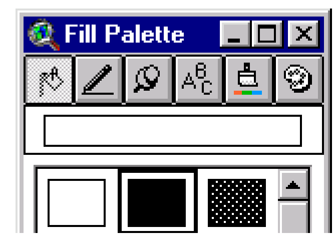
In this exercise, we will estimate different types of land use and pollutant loadings for the town of Rowley based on MassGIS watershed analyst model outputs.



To begin, open the MassGIS dataviewer.

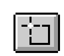
Click on the **Extent List** button,  scroll down, and choose the category **MA Towns**. After clicking **OK**, scroll down the list of towns to choose the extent for **Rowley**.

Since we only want to determine land use for Rowley, we will select that town and make a shapefile of it.



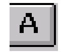
Before selecting Rowley, we must make the **MA Towns** theme **active**.

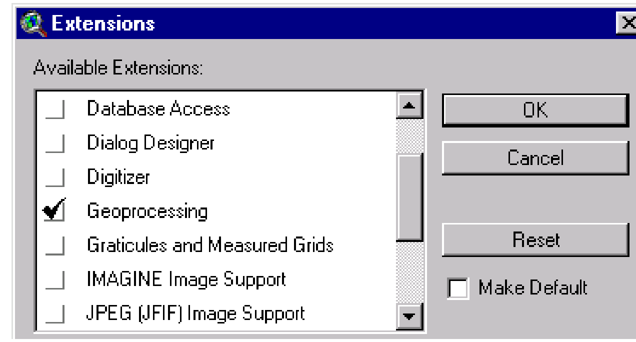
Now we must choose a fill for the polygon so we can see the selection. Bring up the **Legend Editor** by double clicking on the theme. Double click on the symbol box to bring up the **Fill Palette**. Choose the **solid** fill pattern and click **Apply** in the Legend Editor dialog box. **Close** the Legend Editor and Fill Palette before moving on.

To select the Town of Rowley, choose the **Select Feature** tool  and click on Rowley.

To make this highlighted town its own shapefile, go to the **Theme** pull down menu and choose **Convert to Shapefile**. Save this file with the name **Rowley** to your **c:/training** directory and click **Yes** when asked if you want to add the shapefile to your view. Turn this new theme on before continuing.

Now we will add the Land Use layer to your view and clip it to the town of Rowley so we can begin to calculate land use statistics of land cover, pollutant loadings, and impervious surface estimates.

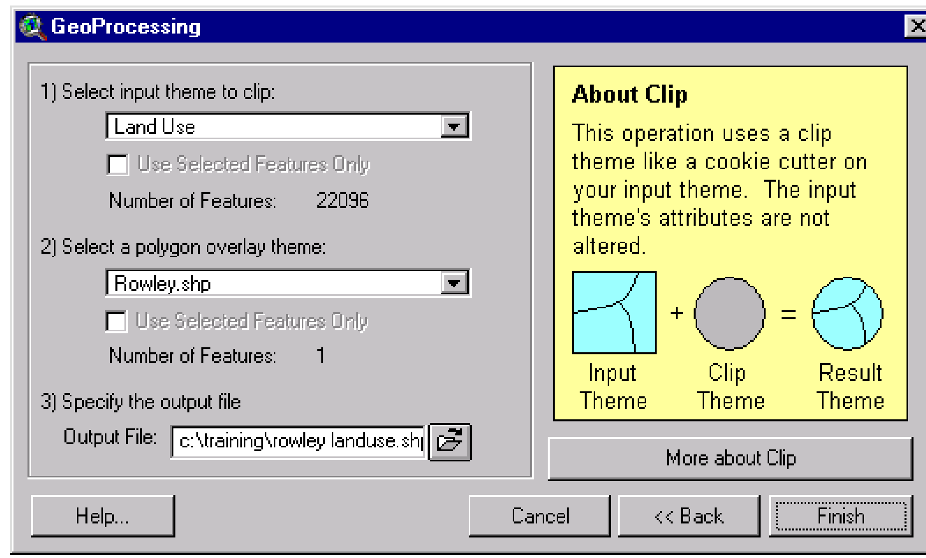
Click the Data Viewer **Theme List** button,  navigate to Physical Resources/Land Use/and Land Use-21 Classes-Solid Colors, and click **OK**. In your view, the Land Use theme should draw using the MassGIS preset legend.



To clip the Land Use theme to the town of Rowley, we need to use the Geoprocessing Wizard. Go to the **File** pull down menu and choose **Extensions**. From the dialog box that appears, scroll down the list and choose the **Geoprocessing** option. Click **OK**.

From the **View** pull down menu, select the last choice of **Geoprocessing Wizard**.

Select **Clip one theme based on another** and click **Next**.



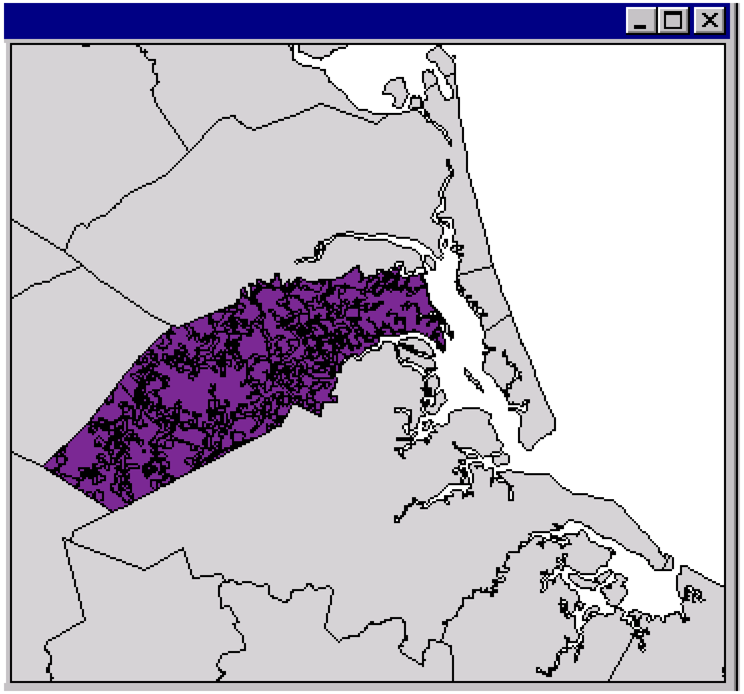
Select input theme to clip as **Land use**.

Select the polygon overlay theme to be **Rowley.shp**.

Save the output file as **Rowley_land use** to the **c:/training** directory.

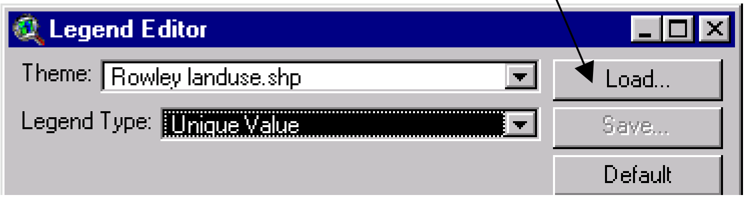
Click **Finish**. The clipping process may take a few minutes depending on the speed of your computer.

Turn the **Rowley_land use** theme on to notice its more limited extent. Also notice that the preset legend has not been added to this new shapefile. Before moving on, turn **off** the original **Land use** theme.

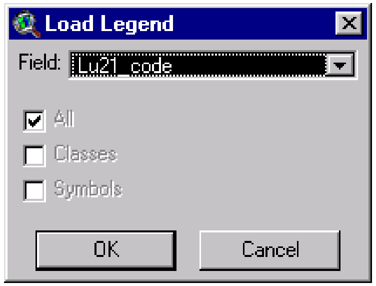


To load in the new shapefile's legend which shows different landuse classes, go into the **Legend Editor** by double clicking on the **Rowley_landuse** theme.

Select **Legend Type** to be **Unique Value**. To load in a preset legend from MassGIS, click the **Load** button.



Navigate to the **c:\training\wq\land use** directory to find two .avl legend files that have been created by MassGIS for the land use coverage. The first, **lu1211p.avl** is a legend with solid fill. The second is **lu1212p.avl** is a transparent fill. For the purposes of this exercise, choose **lu1211p.avl** as the solid fill legend.



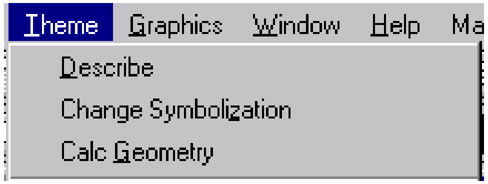
To load this legend properly into the **Rowley_land use** theme, we need to select a field to be represented in the new legend. Choose **Lu_21code** and click **OK**.

Notice how the **Legend Editor** changes to represent land use types.

Click **Apply** and **Close** the Legend Editor.

IMPORTANT. O*ne ArcView limitation is that land use polygons that have been clipped using the GeoProcessing Wizard will not have an updated area and perimeter. For example, the polygons on the border of Rowley have been cut to a smaller size during the clipping process. Thus, the area and perimeter fields for the resulting Rowley_landuse theme will have values larger than they should be for polygons that were clipped along the border. Since the area and perimeter of the clipped coverage should be smaller, we need to recalculate these values. Luckily, MassGIS has made this easy for us! Continue on to see how.*

Make sure the Rowley land use theme is **active**. From the **Theme** pull down menu, choose Calc Geometry

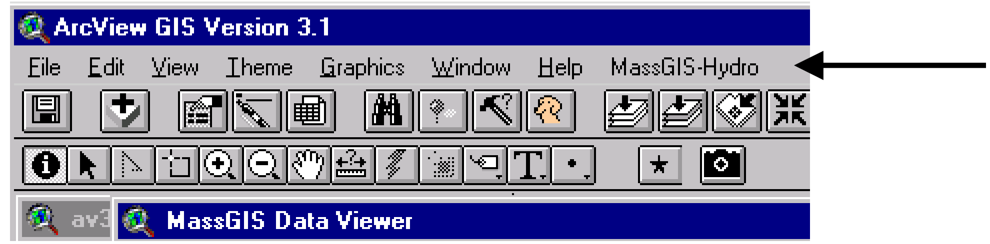


You will be asked whether or not you want to update Area and Perimeter. Click **YES**!

Now that the area and perimeter of the clipped coverage is updated, you can continue with land use calculations of impervious surface, pollutant loadings, and land cover estimates.

NOTE: FOR EACH THEME YOU CLIP USING THE GEOPROCESSING WIZARD, YOU WILL HAVE TO RUN THIS CALCGEOMETRY FUCTION OR ELSE YOUR LAND USE ESTIMATES WILL BE INNACURATE.

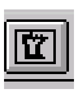
On the ArcView menu bar, you will notice a **MassGIS Hydro** selection which is unique to the MassGIS dataviewer and does not normally appear in the ArcView interface. We will use this tool to calculate land use statistics for the town of Rowley.

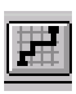


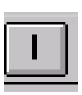
From the MassGIS Hydro pull-down menu, choose to **Display Watershed Analyst**. Notice new buttons get added to your view. *Note: although you need to have the ArcView Spatial Analyst extension to use much of the watershed analyst tools, you can determine land use and pollutant loadings without this extension.*

Make sure the **Rowley_landuse** theme is active and open up its table. 

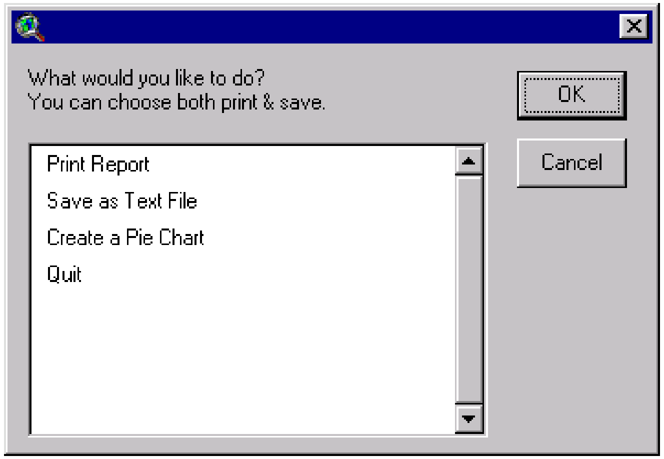
Notice that there are three new buttons added to your table button bar which can be used to perform the following tasks:

 summarizes land use in a defined area,

 estimates nonpoint source loading from the defined area,

 estimates impervious surface cover in the defined area.

Click on any of these buttons to generate a report. For each report, a dialog box will appear that allows you to save, print, or make a chart of the results.



IMPORTANT. *When using this information, be sure to read the text describing data methods and limitations shown at the bottom of each report. All estimates are based on the MassGIS watershed management model. It is important to remember that these estimates are based on land use at a specific time and may not reflect yearly or seasonal variations.*

Close the MassGIS dataviewer project before moving onto Exercise 3.

END

3. Viewing Great Marsh images

Exercise 3A	Half-meter orthophotography
Exercise 3B	Mosaiced half-meter orthophotography
Exercise 3C	NOAA nautical charts
Skills	• Use ArcView extensions • Add images to a project

Estimated Length: 20 minutes

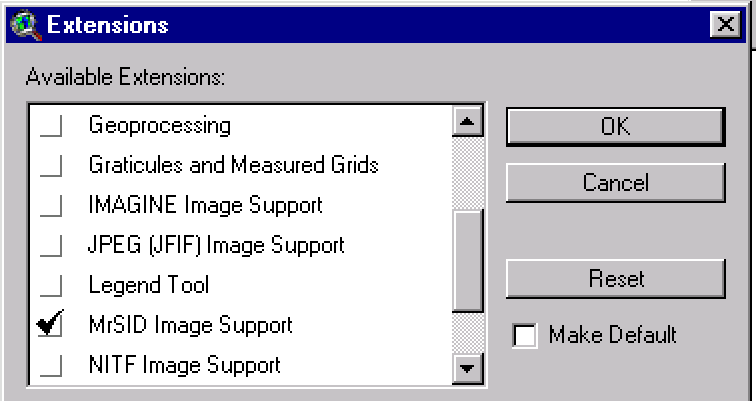
Exercise 3A. Viewing half-meter orthophotography

For this exercise you will need the Great Marsh GIS CDROM in your computer to access the appropriate image files.

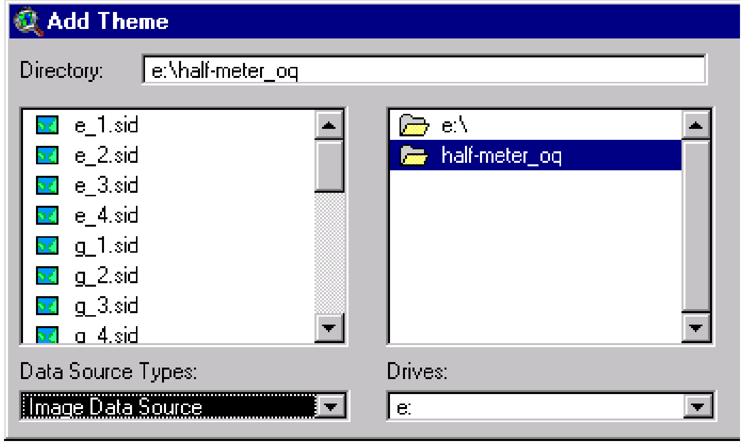
Open ArcView with a **New View**.

When asked if you want to add data, choose **No**.

From the File pull down menu, choose **Extensions** and scroll down the list to choose the **MrSID Image Support** Extension. Click **OK**.



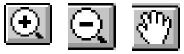
With your View active, click on the **Add Theme** button  and navigate to the CD drive. Choose the **half-meter_oq** directory.

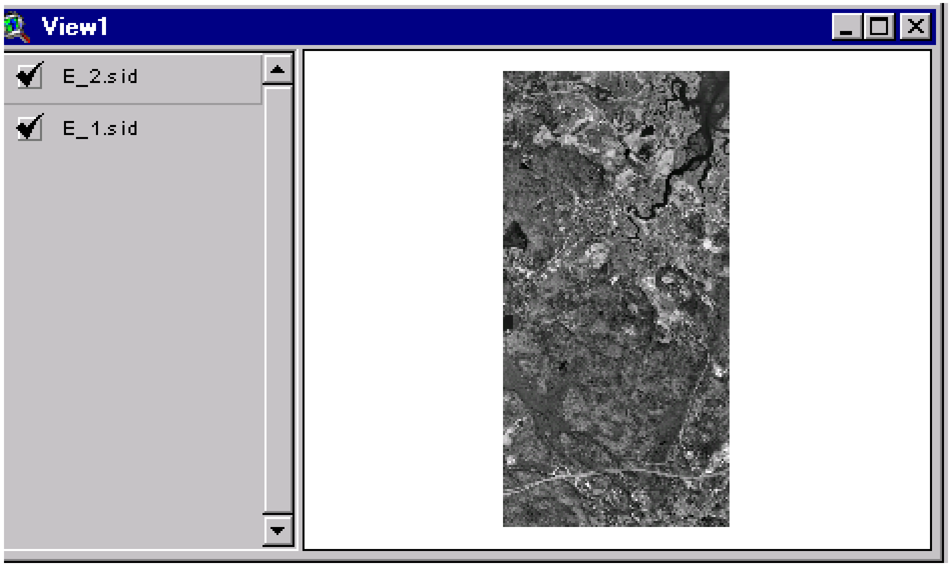


Since we will be looking at images, change the **Data Source Types** to **Image Data Source**.

The half-meter orthophotos available on this CDROM extend from the coastal towns of Salisbury to Rockport. Notice that the name of each file has a letter and number. The letter stands for the town name, (e, g, i, n , np r, rp, and s = Essex, Gloucester, Ipswich, Newbury, Newburyport, Rowley, Rockport, and Salisbury). Where there are two town names (i.e, r_i = Rowley_Ipswich) this indicates that the orthophoto extent crosses two town boundaries.

Add any of these half meter othophotos and turn them on to view their detail and extent.

Use the **zoom** and **pan** tools to move around to areas of interest in the image. 



Turn these themes off before moving on.

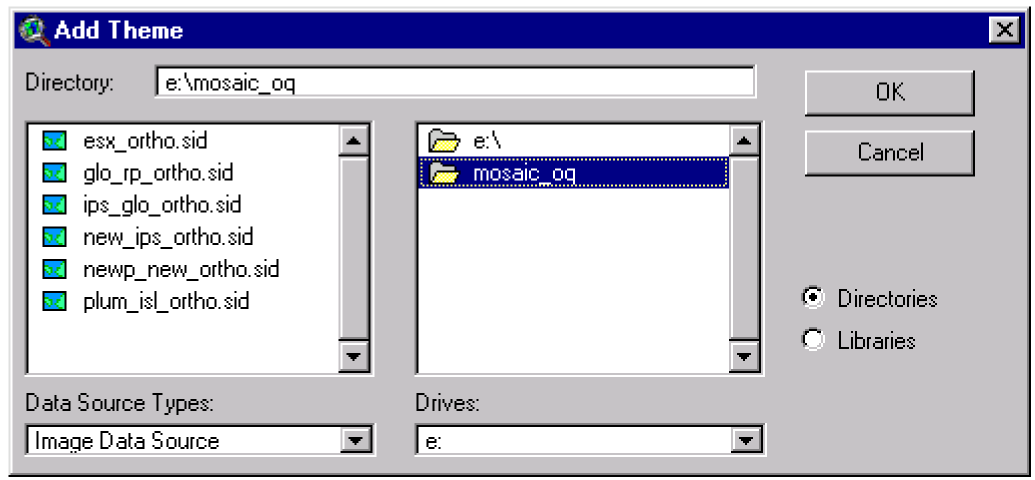
Exercise 3B: Viewing mosaiced half-meter orthophotography

Rather than viewing each orthophoto individually, it is often more useful to view them in combination to get a regional picture. The coastal orthophotos have been mosaiced together into 6 images. To view these, make sure the MrSID extension is still loaded into your project from Exercise 3A.

NOTE: the file size for each mosaiced orthophoto image is very large and will take a long time to draw in your view if you do not have adequate RAM on your computer.

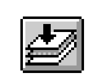
To add an orthophoto mosaic, click the **Add Theme** button  and navigate to the CDROM directory.

Navigate to the **mosaic_oq** directory and be sure the **Image Data Source** is chosen.



Use the **zoom** and **pan** tools to move around to areas of interest in the image. 

Select any or all of these images and click **OK**.

Turn the new image on in your **Table of Contents**, make it active, and click the **Zoom to Active** theme button. 

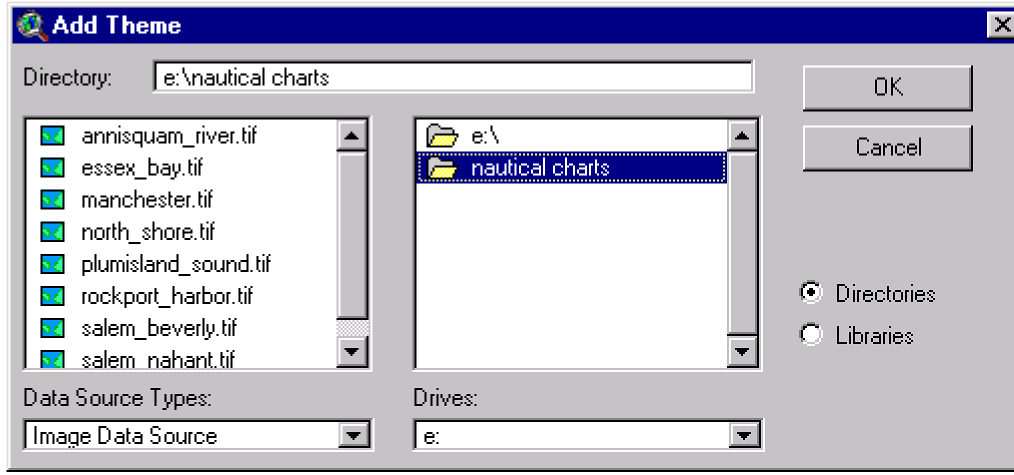
Notice how each of these mosaiced images has a much larger geographic extent. Turn any of these themes **OFF** before moving on.

Exercise 3C: NOAA nautical charts

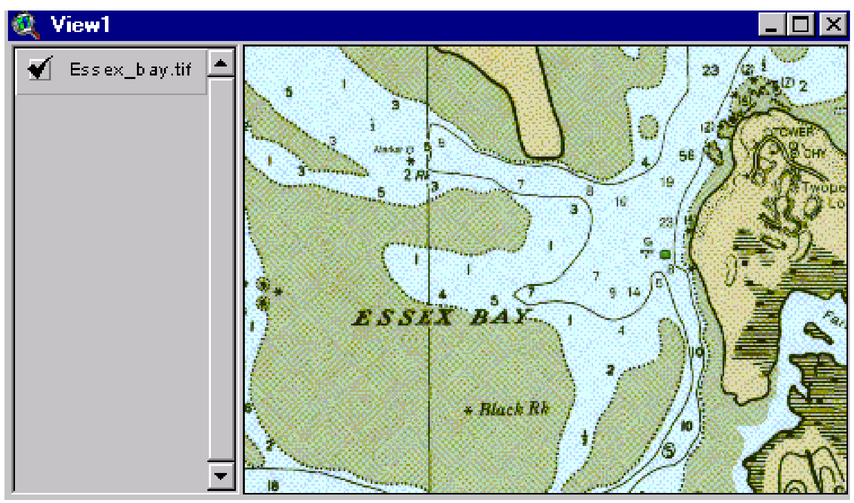
To view the NOAA nautical charts, click the **Add Theme** button again and navigate to your **CD** drive. Choose the directory **nautical charts**.

Select any of the charts you might be interested in and click **OK.**
*Be sure that the **Image Data Source** is chosen.*

Make the theme active and click the **Zoom to Active Theme** button.



Again, use the Zoom and Pan tools to focus on different areas of the nautical chart added.



END

4. Creating a point shapefile

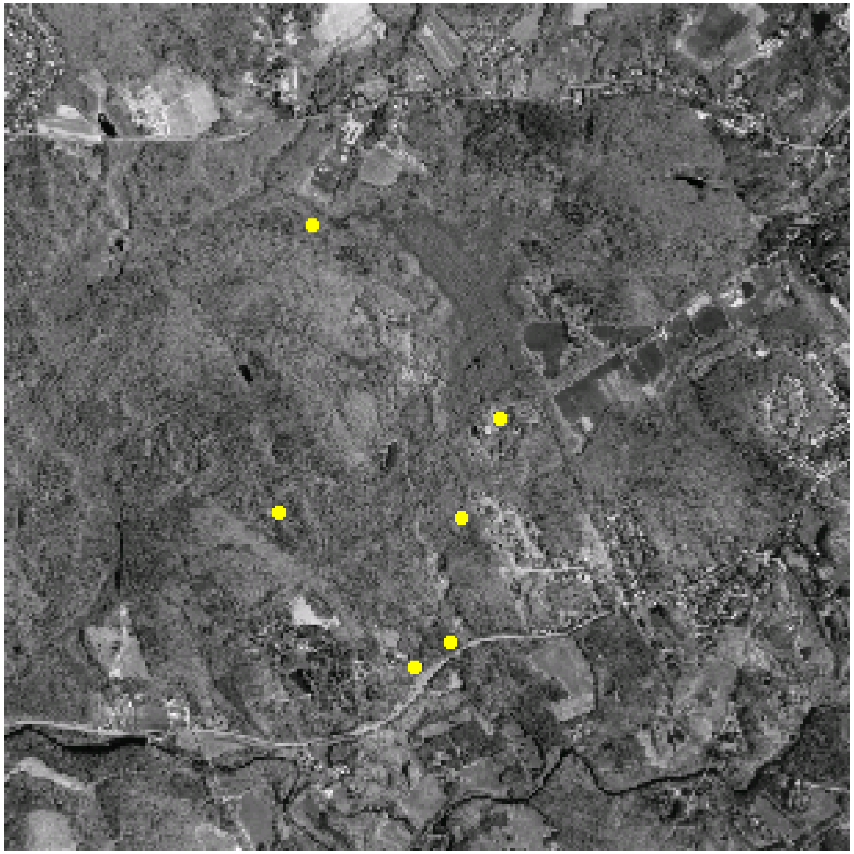
Exercise 4	Identifying vernal pools
Skills	• Create a point shapefile • Add attribute data to the new theme

Estimated Length: 15 minutes

Exercise 4. Creating a point shapefile

This exercise will show you how to add points where you've recently identified vernal pool habitats from field surveys.

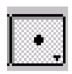
Navigate to **c:/training/point** and open the **point.apr** project. When the project opens, you see a view with an aerial photo taken from Ipswich. Luckily, you have been given data from field surveys which show approximate locations of vernal pools for this aerial photo's extent. Your task is to make a point shapefile of the hand drawn vernal pools shown by an **X** in the photo on the right.



From the **View** menu, choose **New Theme**.

Click **OK** in the New Theme dialog box which already has the default of **Point** entered.

Save the new theme to the **c:/training/point** directory and name it **vernal pool**.

Click on the **Draw Point** tool  and click points on the photo where your hand drawn map from the previous page indicates that vernal pools are located.

From the **Theme** menu, choose **Stop Editing** and **Save** the changes you've made.

If the default color chosen for your points is a dark color, change to a lighter color using your **Legend Editor** so you can see their locations more clearly.

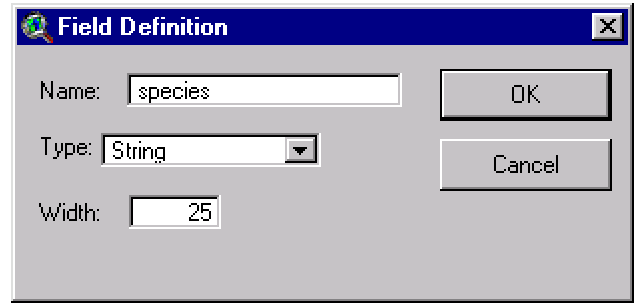
You also want to enter data you collected in the field about each vernal pool. To do so, make sure the **Vernal pool** theme is **active** and open its attribute table. 

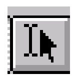
From the **Table** menu, choose **Start Editing**.

From the **Edit** menu, choose **Add Field**.

Since we want to add information about the species found in each pool, name the new field **species**, change the type to **String** and the width to **25** (this number indicates how many characters you will need in the new field).

Click **OK**.



Click the **Edit** button  and begin entering a unique ID for each point along with known species information in your new field. To save each record, you must hit the **Enter** key after you are done typing all the information in each cell.

When you finish entering your text, go to the **Table** menu and choose **Stop Editing**. Choose **Yes** when asked if you want to **Save** edits.

You have now created a new point shapefile with attributes added to the table. This theme has been saved and can be used in any of your other ArcView projects.

END

5. Environmental Sensitivity Index

Exercise 5A	Shoreline resources
Exercise 5B	Biological resources
Exercise 5C	Explanation of ESI tables
Skills	• Clip themes • Load pre-set legends • Calculate length • Reproject themes • Perform theme queries

Estimated Length: 60 minutes

INTRODUCTION

The main objective of an oil spill response is to reduce environmental consequences of both spills and cleanup efforts. It is necessary to identify vulnerable coastal locations before a spill occurs so that protection priorities can be established and cleanup strategies identified in advance. To meet this need, the NOAA Hazardous Materials Assessment and Response Division (HAZMAT) researchers have produced Environmental Sensitivity Index (ESI) maps.

ESI maps are comprised of three general types of information.

- Shoreline classification: shoreline scales are ranked according to sensitivity, natural persistence of oil, and ease of cleanup.

- Biological resources: oil-sensitive animals such as seabird colonies, habitats, and rare plants are depicted by special symbols on the maps.

- Human-use resources: sensitive areas, such as beaches, parks, marine sanctuaries, water intakes, and archaeological sites are identified because of their added value and use.

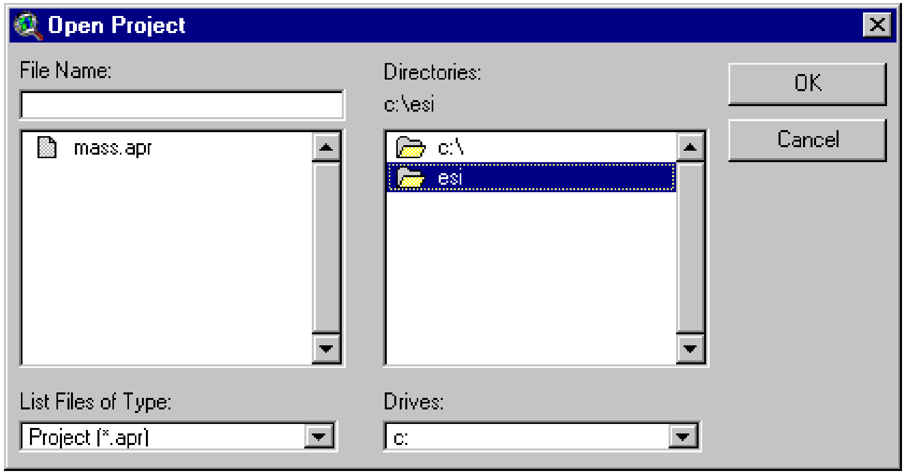
Traditional ESI maps were produced as color-coded paper maps, with limited distribution and without a means for ready updating. However since 1990, ESI project members began using GIS to produce maps that are higher in quality and can be easily updated. Since it is important to define what comprises the ESI mapping system, this ArcView exercise will teach users how information is being developed and distributed using GIS technology and how it can be used to address oil spill and human resource concerns.

NOTE: this exercise serves only as a guide to illustrate ways that ESI data can be utilized in decision making processes. For more information on ESI data collection methods or their geographical extent, you should consult the metadata available from MassGIS and contained on this CD-ROM in the directory ***/esi/metadata****.*

Coastal habitats are unique areas of high productivity supporting a diverse array of organisms including many commercially and ecologically important species. These habitats are particularly vulnerable to oil spills because of the persistence of oil in intertidal and subtidal sediments and the impacts of associated clean up activities. Oil spills affect nearshore waters, benthic sediments, intertidal habitats, and adjoining habitats above high tide. Thus, assessment of injuries to coastal resources requires consideration of the shoreline type, biological resources, and human use resource information contained in an ESI map.

To begin looking at the shoreline and biological ESI data in the Parker River/Essex Bay Area of Critical Environmental Concern (ACEC), choose **Open Project** from the ArcView **File** menu.

Navigate to the **mass.apr** project located in the **c:\esi** directory. After highlighting this project name, click **OK**.



Since this project contains complex datasets and linked tables, the view may take a few seconds to open. Notice all the attribute tables that pop up as the project opens. These tables are linked together to make it easier to select a feature in the view and evaluate its associated table records. However, these links also make the project format very complex.

Exercise 5A. Shoreline resources

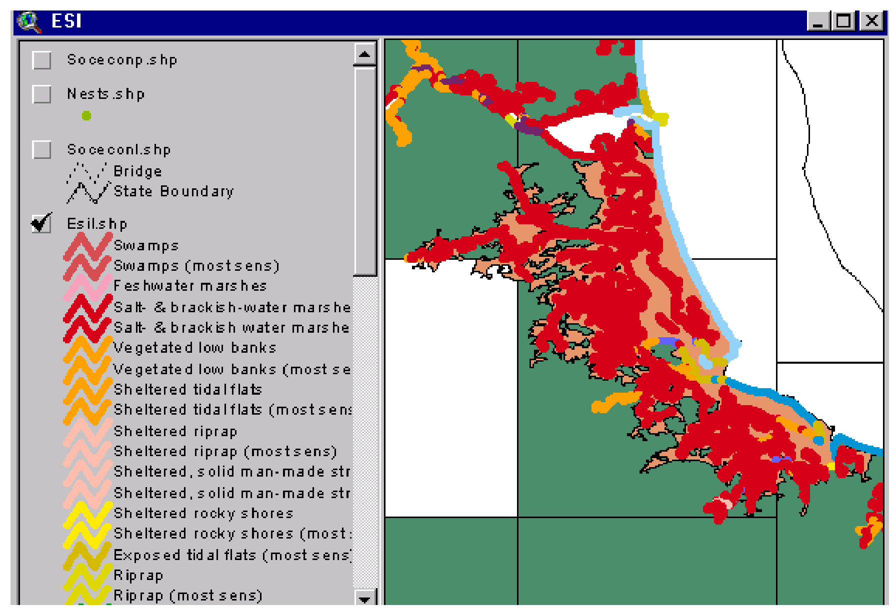
The view opens with a grid of the Massachusetts shoreline. Drag the **View** to the middle of your screen. To make the **Table of Contents** easier to view, make the **Soceconp** theme active, go to the **Theme** pull down menu, and choose **Hide/Show Legend** (perform this operation for the **Esil** theme too). Scroll down the Table of Contents to see what kinds of data are included in the ESI project.

IMPORTANT. For the purposes of this exercise, we are interested in looking at ESI data in the Parker River/Essex Bay ACEC. However, this ESI data is projected in decimal degrees and will not overlay any themes from the MassGIS database (MassGIS data has the projection State Plane/NAD83/meters). MassGIS is working to reproject ESI data to make it available in compatible formats in the future. For this exercise, the ACEC boundary has been reprojected to decimal degrees so that it will overlay ESI data.

Using the **Add Theme** button,  add the **ACEC** theme using the path **c:/esi/ACEC**. Turn this theme on, make it active, and click the **Zoom to Active** theme button.  Your view should now be focused on the Parker River/Essex Bay ACEC located on the North Shore of Massachusetts.

To view shoreline types in the ACEC, turn on the **Esil.shp** theme. Since the Acec theme masks this line theme, drag the **Acec** theme below the **Esil** theme in the **Table of Contents**.

Make the **Esil** theme active, and choose **Hide/Show Legend** from the **Theme** menu.



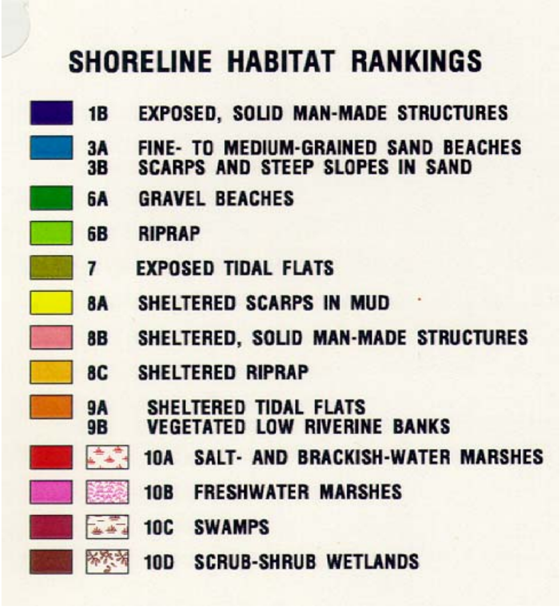
Shoreline habitats have a high likelihood of being directly impacted by an oil spill. The standard ESI shoreline rankings include estuarine, lacustrine, and riverine habitats. Each ranking scheme is based on an understanding of the physical and biological character of the shoreline environment - not just the substrate type and grain size. The sensitivity ranking is controlled by the following factors:

1) relative exposure to wave and tidal energy
2) shoreline slope
3) substrate type (grain size, mobility, penetration, and trafficability)
4) biological productivity and sensitivity

Areas exposed to high levels of wave action, tidal currents, and low biological activity generally rank low on the scale. In contrast, sheltered areas with associated high biological activity have the highest ranking. For example, the most sensitive shorelines are sheltered tidal flats and marshes. Sheltered tidal flats are very sensitive because of the high density of organisms and low natural flushing rates. Marshes are also considered to have great ecological value because they serve as a nursery ground to numerous species of invertebrates and fish.

Moderately sensitive shoreline types include sheltered seawalls, riprap, shelly beaches, sand beaches, and exposed tidal flats. These locations have harder structures or sediments which allow less oil to infiltrate. Cleanup of beaches and seawalls is relatively easy because oil adhering to sandy shorelines can be rapidly removed by tidal flushing. In addition, species living on beaches and seawalls are quite resilient to most spill impacts.

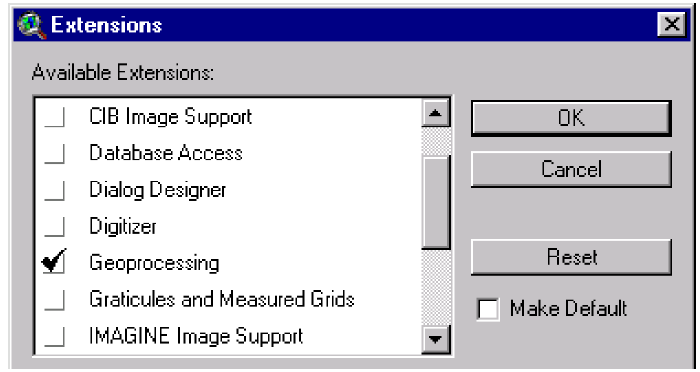
Shorelines of the lowest sensitivity include exposed riprap, seawalls, and man-made structures. The diversity of plant and animal life on the seawalls is very low and does not play a critical role in maintenance of an estuarine ecosystem. The ecological sensitivity, therefore is also very low. In these areas, wave energy effectively removes pollutants and prevents long-term persistence of most surface contaminants.



The shoreline habitats delineated in Massachusetts ESI maps are ranked in order of increasing sensitivity to spilled oil.

To calculate types of shoreline in the ACEC, we need to clip the **Esil** theme to the ACEC boundary. Begin by going to the **File** pull down menu and choosing **Extensions**. Add the **Geoprocessing** extension to your project and click **OK**.

From the **View** menu, select the **GeoProcessing Wizard**.



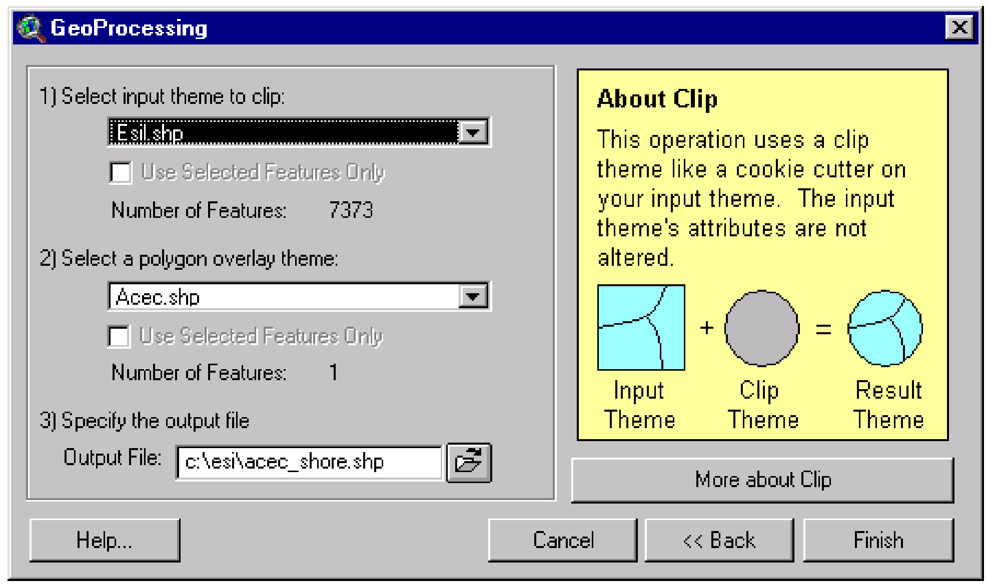
Choose the selection "**Clip one theme based on another**" and click **Next.**

Select **Esil.shp** as the input theme.

Select the polygon overlay theme to be **ACEC.shp**.

Name the output file **acec_shore** and save it using the path **c:\esi\acec_shore.shp**.

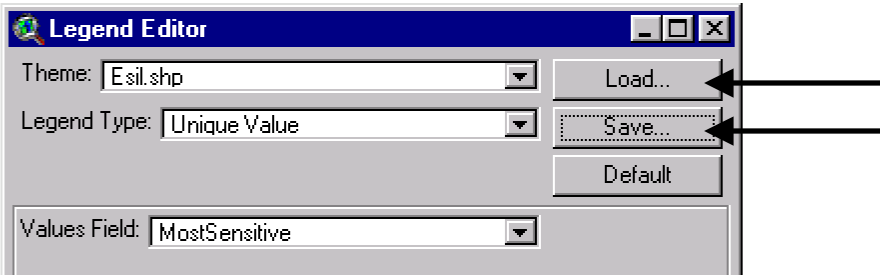
Click **Finish** to begin the clipping process.



Notice that the new theme **Acec_shore** does not have the same legend as the original **ESI** line theme. This happens because the preset legend from the source theme does not get saved when a new shapefile is made. To transfer the original legend, make the **Esil** theme active, and **double click** on it to view the **Legend Editor**.

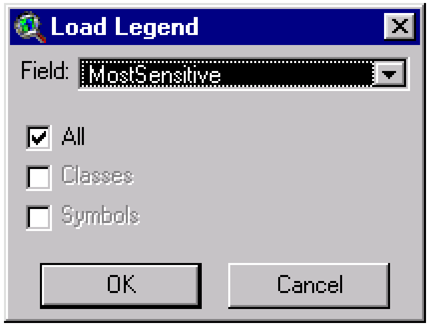
In the **Legend Editor**, click the **Save** button.

Navigate to the **c:/esi** directory and name the legend **esi_line**.



Move the **Legend Editor** aside and double click on the **ACEC_shore** theme in **the Table of Contents** to view its **Legend Editor**.

Click on the **Load** button and navigate to the **c:\esi\esi_line** legend file you just saved. Click **OK**.



Load the legend into the Field **MostSensitive**, and click **OK**.

*NOTE: the **Salt and brackish water label** has a value of **10A** and **10A+**.*
We will use this value in the next exercise to calculate the length of this shoreline type.

Back in the Legend Editor, click **Apply**.

Turn off the **Esil** theme and hide its legend by making it active and choosing **Hide/Show Legend** from the **Theme** menu.

Turn on the **Acec_shore** theme. Notice that the clipping process now allows us to view only the shoreline within the ACEC.

SELECTING SHORELINE TYPES

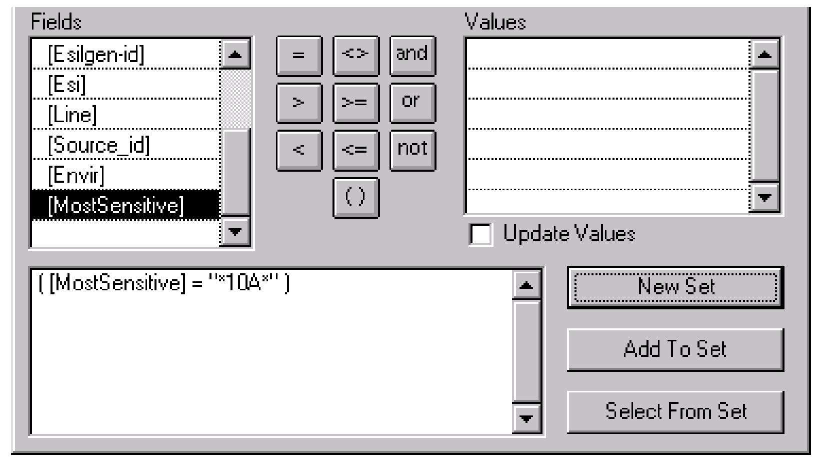
We will now do a query to select the **salt and brackish water marshes** with the code of “**10A**” and calculate their length.

Begin by clicking on the **Query** builder button. 

To choose marsh shorelines, scroll down the **Fields** list and double click on **Most Sensitive**. Click once on “=“.

Now type the expression **“ *10A* ”** (be sure to include both quotes and asterisks in the expression) . Your final expression should look like the one shown on the right.

Choose **New Set** and close the **Query** builder. The selected arcs now include only marsh shoreline.



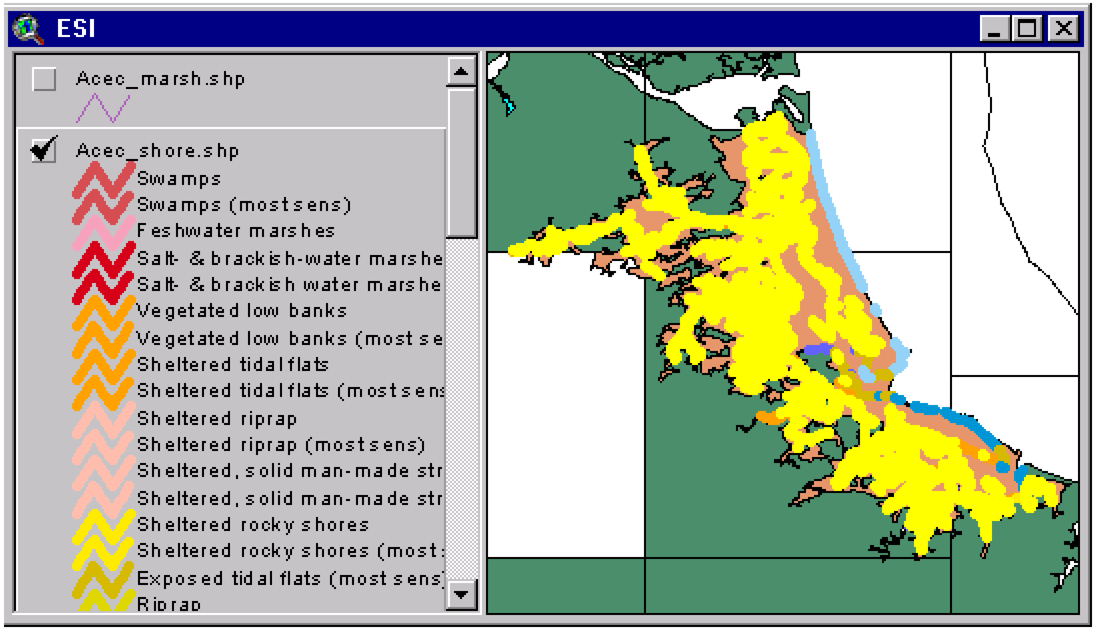
*Note: you will notice that some shoreline codes in the Values list include the symbol “+”. This symbol indicates that a particular arc has more than one shoreline type. For example the code 10A+ for marsh shorelines indicates that this arc may include other codes (i.e. for tidal flats or riverine banks) but that 10A is the most sensitive type. Using the wildcard symbol “ * ” in our query expression will select all codes of 10A including 10A+.*

Make a shapefile of these selected arcs by choosing **Convert to Shapefile** from the **Theme** menu.

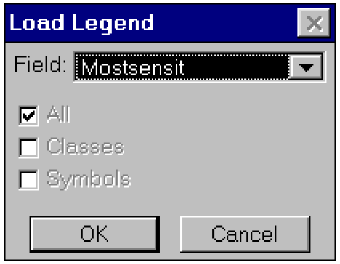
Name the theme **Acec_marsh** and save it to the **c:\esi** directory.

Add the shapefile to your view.

Turn off the **Acec_shore** theme, hide its legend, and turn on the **Acec_marsh** theme.



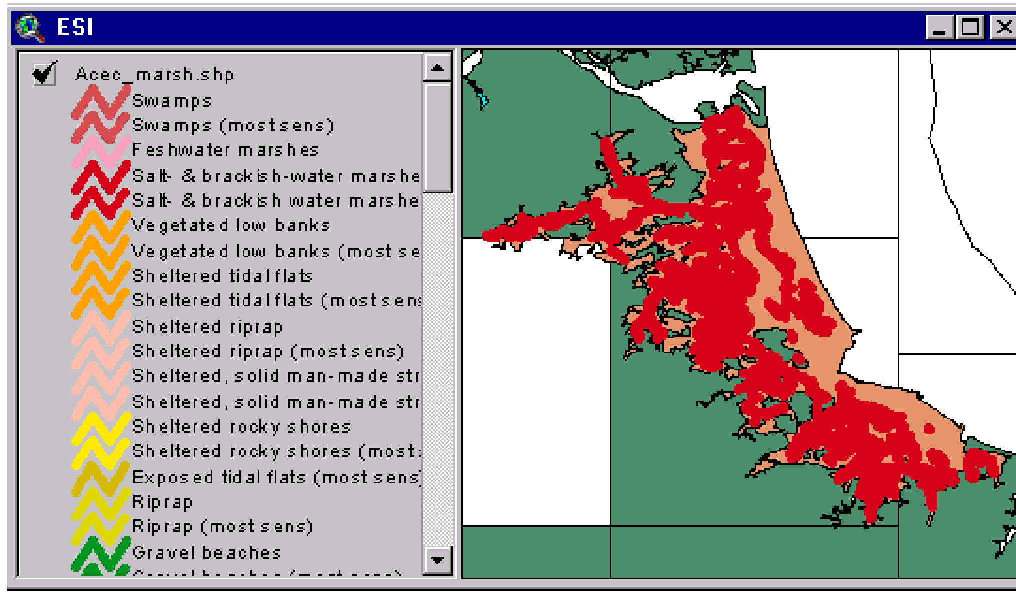
To load the ESI arc symbols, you must go into the **Legend Editor** again by double clicking on the **Acec_marsh** theme in the Table of Contents. Click **Load**, navigate to the **c:\esi** directory and choose **esi_line.avl** file again. From the **Load Legend** box that appears, make sure the **Field** is *Mostsensit* and the **All** box is checked.



Click **Apply** before closing the **Legend Editor**. Notice that only the red codes for salt marsh now appear.

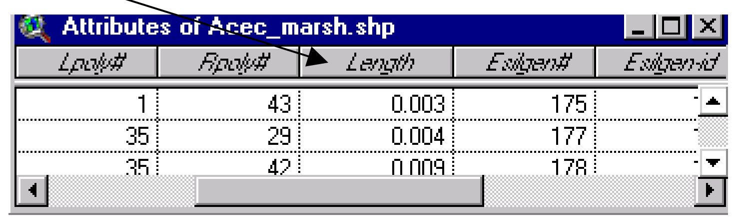
CALCULATING SHORELINE LENGTH

Make **Acec_marsh** the active theme and open its table.



Notice that the **Length** field has units with a magnitude of .001, indicating map units of decimal degrees (remember the data is projected in decimal degrees).

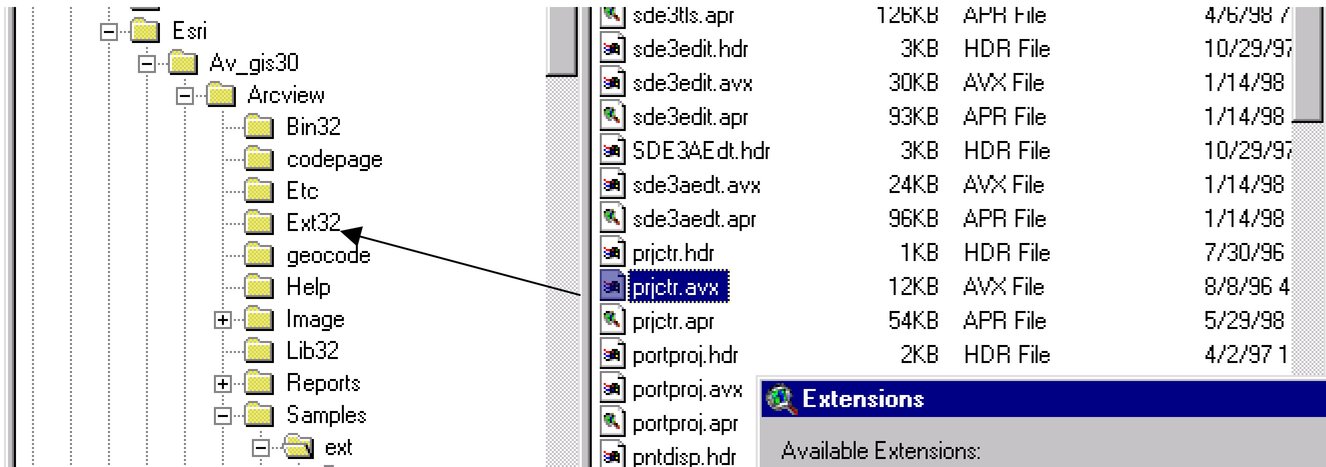
Close the Table.

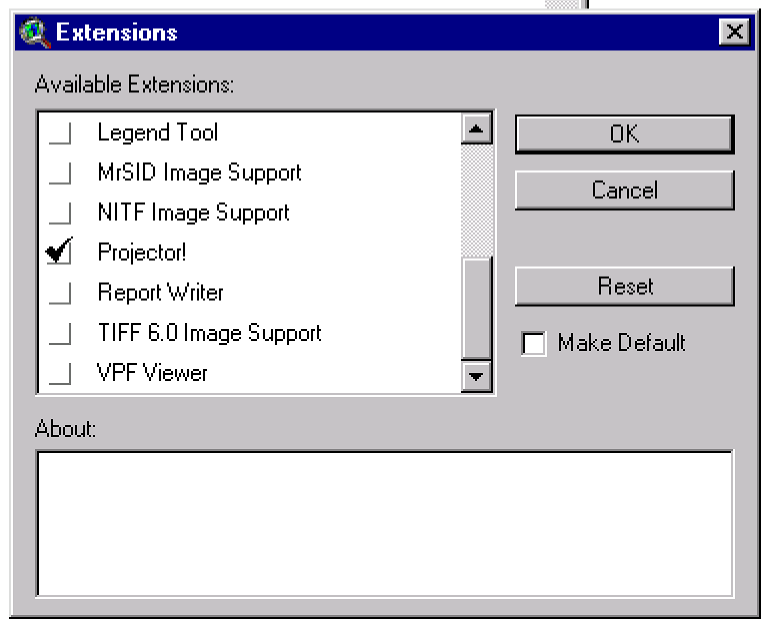


We will now convert this theme into the correct projection for Massachusetts so we can calculate the marsh shoreline length in meters.

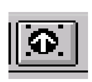
Note: when shapefiles are created, they are using the original theme data (in this case Esil). Since the theme Esil has map units of decimal degrees, then any shapefiles made from it (i.e., Acec_marsh) will have length units in decimal degrees.

Since the **Projector** is not a standard extension in ArcView, we need to add it to our project. To do so, go to your **File Manager** and navigate to the **c:/esri/av_gis30/arcview/samples/ext** directory to find the **prjctr.avx** file. Highlight this file and drag it to the **Ext32** directory. Doing these steps will now make the projector extension available in your ArcView project.





Go back into ArcView and from the **File** pull down menu and choose the **Projector!** Extension. Click **OK**.

Make the **Acec_marsh** theme active and click the **Change Projection** button. 

When asked to pick output units, select **meters** (these are the units needed for data projected in Massachusetts).

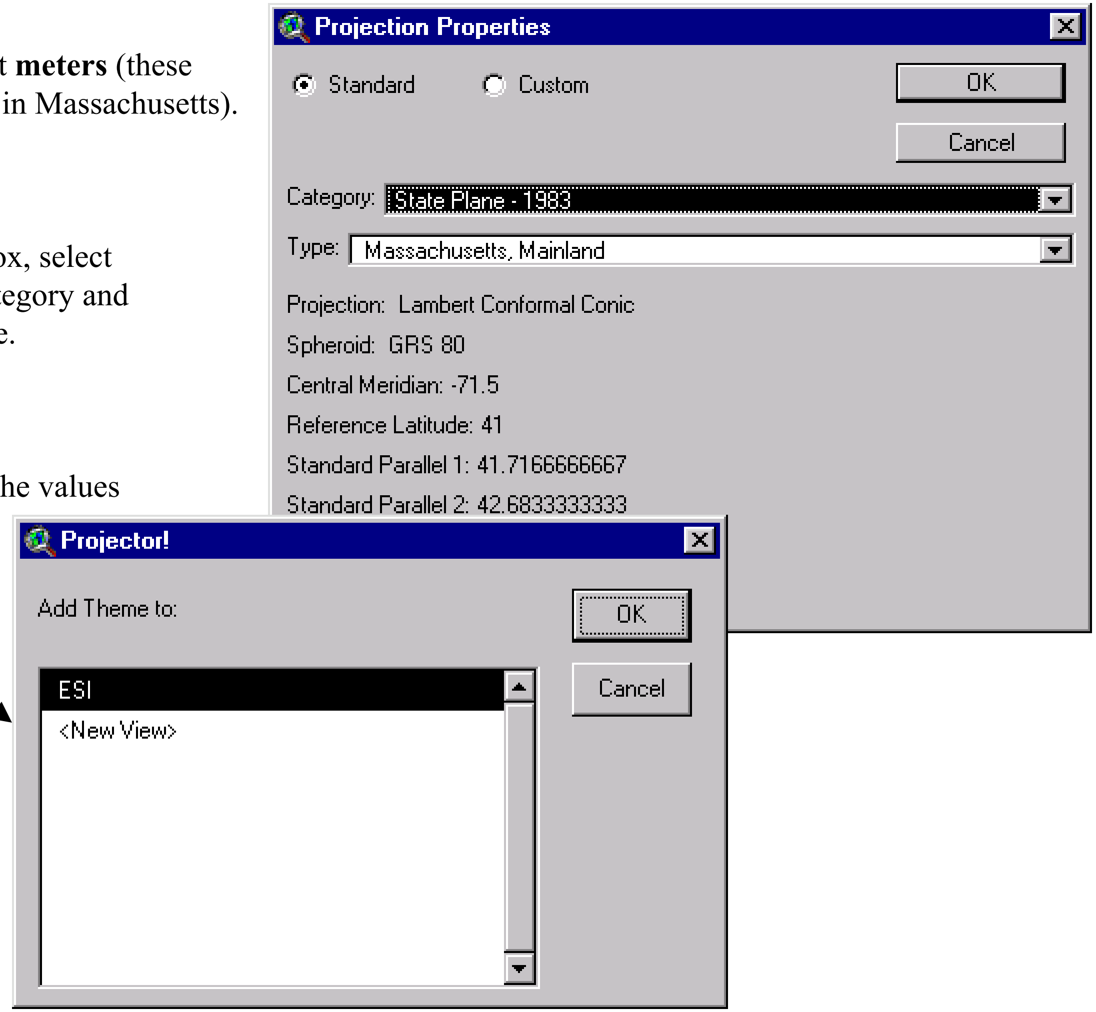
Click **OK.**

In the **Projection Properties** dialog box, select the category **State Plane 1983** for Category and **Massachusetts Mainland** for the Type.

Click **OK**

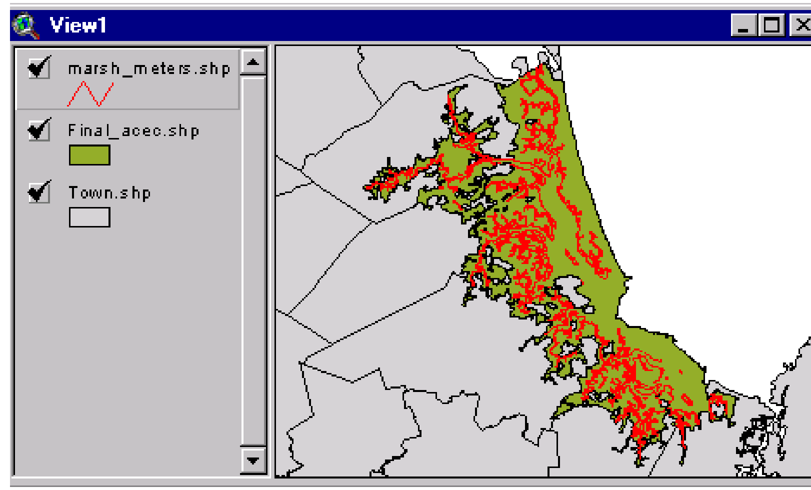
When asked whether or not you want the values recalculated, click **OK**.

Add the theme to a **New View** and click **OK**.

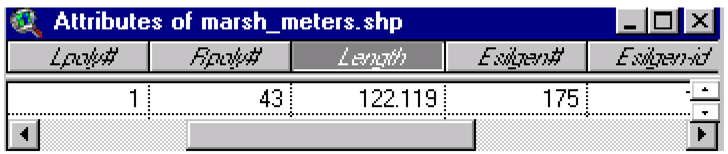


Name the theme **marsh_meters** and save it to the **c:/esi** directory.

From the **c:/esi** directory, add the **Town** and **Final_acec** themes to your new view. Drag the themes so they appear in the following order: **marsh_meters, final_acec, town**.

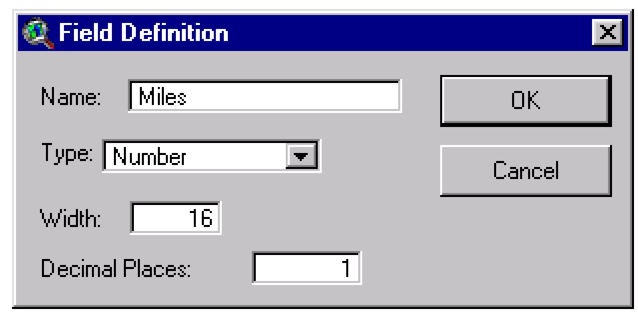


Make **marsh_meters** active and open its table. Notice how the shoreline length has been updated with units of meters since we reprojected the original decimal degree theme to a Massachusetts projection of State Plane/NAD83/meters.

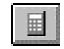


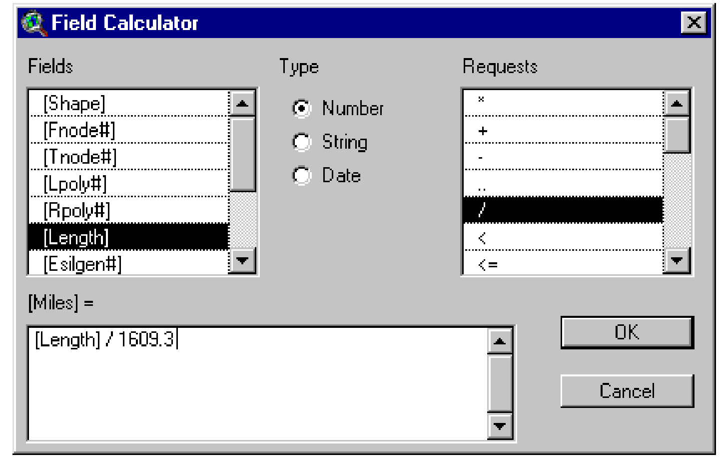
To convert **Length** from meters to miles, choose **Start Editing** from the **Table** menu.

From the **Edit** menu, choose **Add Field**.



In the dialog box that appears, name the new field **Miles** and choose **1** as the number of decimal places. Click **OK**.
Notice that the new field Miles has been added to the table on the right.

To convert meters to miles, click the **Field Calculator** button. 



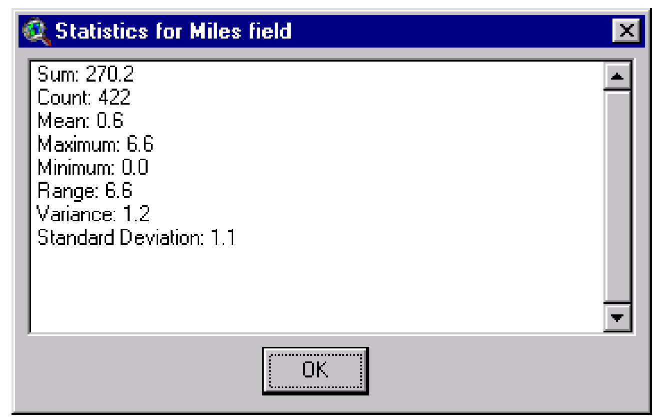
From the **Fields** menu choose **Length**. Double click on the divide symbol "/" from the **Requests** list.

Since 1 mile = 1609.3 meters, type the value **1609.3** to complete the expression shown on the right. Click **OK**.

Notice the table now has a field with miles values for length.

Since we want to calculate the total miles of marsh shoreline within the ACEC, select the **Length** field by clicking on the column title.

From the **Table** menu, choose **Stop Editing** and **Save** the edits.



Since we want to calculate the total miles of marsh shoreline, make sure the **Miles** column is selected and choose **Statistics** from the **Field** pull down menu. These results show that a Sum of 270.2 miles of marsh shoreline are within the ACEC.

Click **OK** to close the **Statistics** box.

Note: this same method could be used to determine the length of other types of shoreline (i.e., tidal flats) within a the ACEC or other areas of interest (i.e, town boundary, wildlife refuge, etc).

From the File menu, choose **Close All** to close the project.

DO NOT save the changes since we want to use the original ESI project in the next exercise.

Exercise 5B. Biological resources

There are numerous animal species that are potentially at risk from oil spills. Toxic effects leading to death or reproductive failure can occur if organisms ingest or get coated by the oil. Therefore, it is important to document and quantify injuries to biological resources found in the shoreline areas affected by an oil spill.

ESI biological resource data are organized into six major groups, each with a unique reference color: birds (green), mammals (brown), fish (blue), shellfish (orange), reptiles (red), and rare\endangered plants and special habitats (purple). These colors are used to fill hatched polygons. In the project window, there are also four linked tables: ***biofile***, ***soc_dat***, ***breed***, and ***sources***. Two of these data tables (***biofile*** and ***breed***) contain information about the biological resources. Biological information organized by group (birds, fish, etc.) describes the species name, status as threatened or endangered on state and Federal lists, concentration (specifically for each point or polygon), presence by month, and special life-history time periods. Seven major categories of biological resources are included in this project: marine mammals, terrestrial mammals, birds, reptiles\amphibians, fish, invertebrates, and habitats\rare plants.

Biological information presented in this project was collected and compiled with the assistance of biologists and resource managers from federal and state agencies and conservation groups.

This exercise will illustrate the use of ESI biological data by looking bird habitat in the Parker River/Essex Bay Area of Critical Environmental Concern (ACEC).

BIRD HABITAT

Coastal areas are important feeding grounds for wading birds, waterfowl, and many diving birds. Many of these species use marsh and swamp habitat as their primary habitats for nesting. Oiling of birds reduces the buoyancy, water repellency, insulation provided by feathers, and may result in death by drowning or hypothermia. Oiling can also severely impact breeding and nesting success, especially if oiled adults contaminate the nest, eggs, or young. Birds are a major component of the Massachusetts ESI atlas and are divided into several species subgroups based on taxonomy, morphology, behavior, and oil spill vulnerability and sensitivity.

From the **Project** window, open the **mass.apr** project from the **c:/esi** directory. In the project, you will see four tables open: ***biofile, soc_dat, breed,*** and ***sources***.

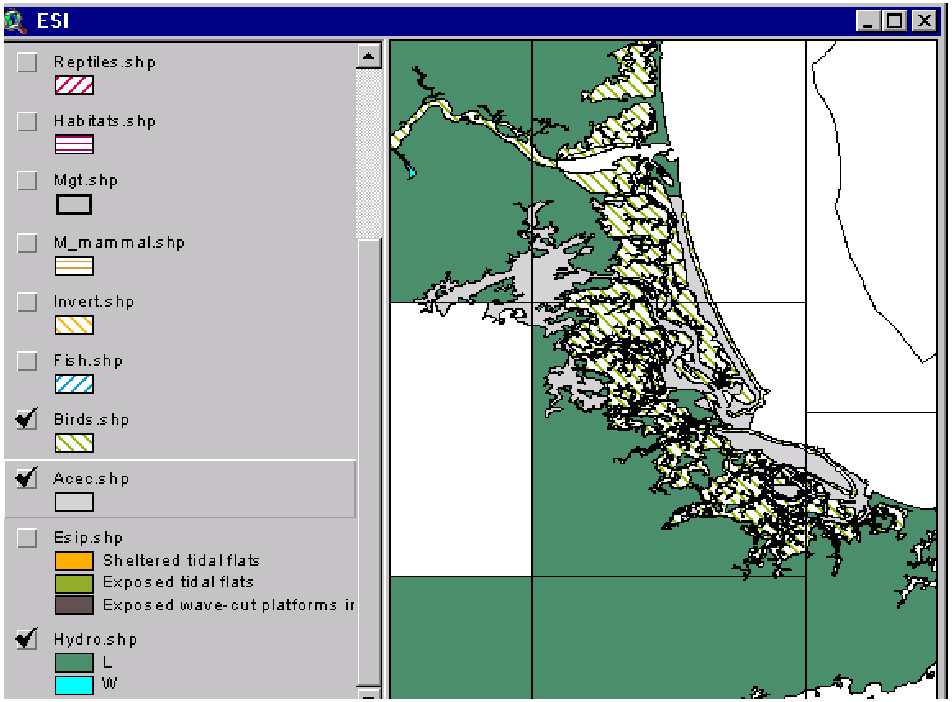
Note: As you will see shortly, these tables are all linked together so selecting a record in one may also select records in others. Try to avoid accidentally clicking on any of the entries to prevent the program from spending time searching through all of the tables.

Make the **ESI View** active and hide the **Soceconp** and **Esil** theme legends by using the **Hide/Show Legends** from the **Theme** pull down menu.

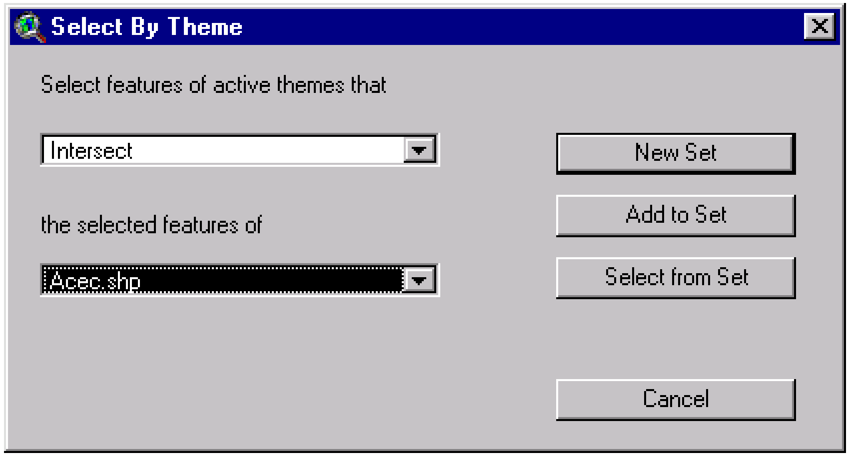
Add the theme **Acec** from the **c:/esi** directory. Make this theme active and click the **Zoom to Active** theme button. 

Scroll down the **Table of Contents** (move the View up to the center of your screen so you can see the entire table of contents) and turn on the **Birds** theme to begin looking at the location of species the ACEC.

Turn on the **Acec** theme and drag it below the **Birds** theme in the **Table of Contents**.



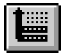
To begin performing a query to identify bird habitats in the ACEC, make the **Birds** theme active and choose **Select by Theme** from the **Theme** menu.

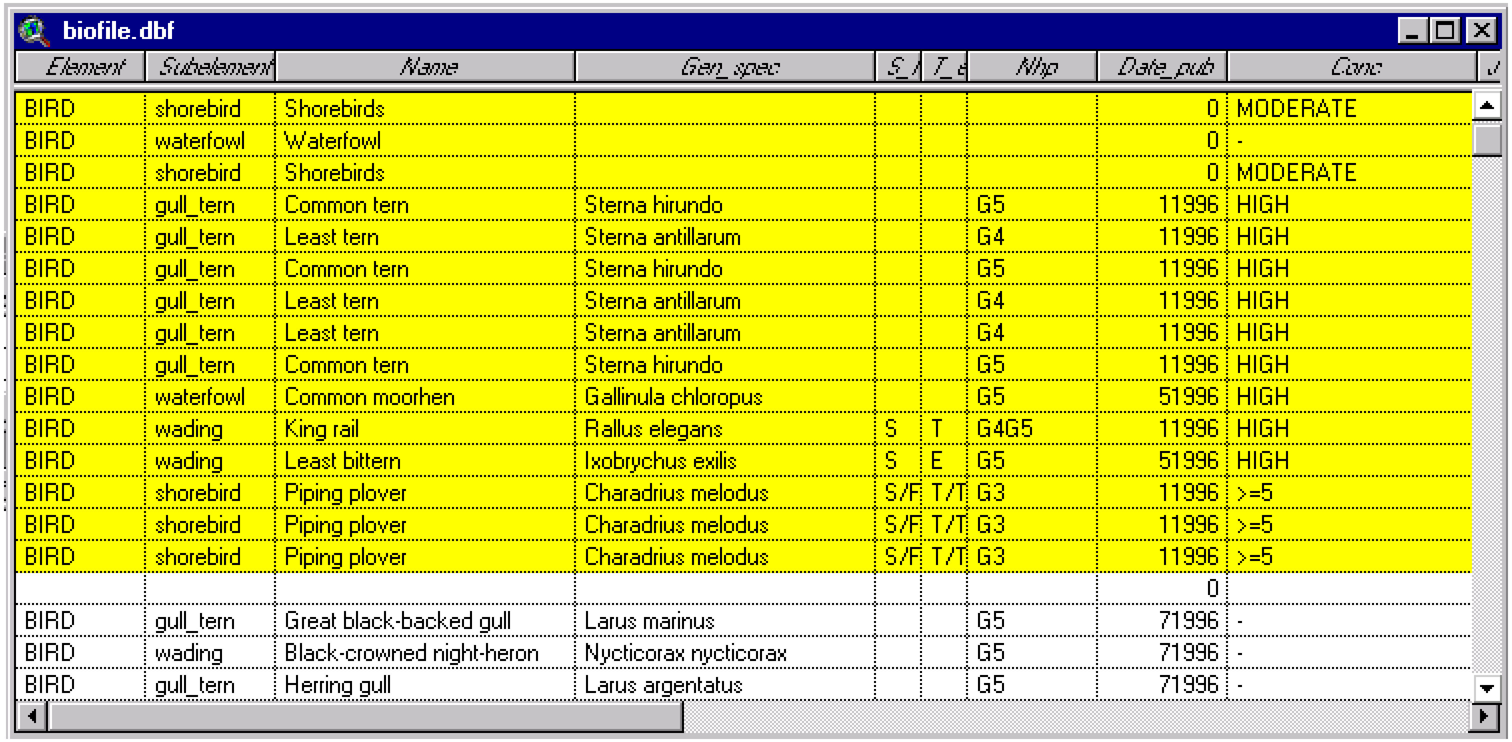


Select features of the active theme that **Intersect** the selected features of **ACEC**.

Click **New Set**.

Notice that the records for selected bird polygons become highlighted in the linked **Biofile** table.

Make the **Biofile** table active and click the **Promote** button  to bring the selected records to the top. Make this table bigger so you can see all selected records of birds identified within the ACEC.



biofile.dbf

Element	Subelement	Name	Gen_spec	S_	T_	Nhp	Date_pub	Conc
BIRD	shorebird	Shorebirds					0	MODERATE
BIRD	waterfowl	Waterfowl					0	-
BIRD	shorebird	Shorebirds					0	MODERATE
BIRD	gull_tern	Common tern	Sterna hirundo			G5	11996	HIGH
BIRD	gull_tern	Least tern	Sterna antillarum			G4	11996	HIGH
BIRD	gull_tern	Common tern	Sterna hirundo			G5	11996	HIGH
BIRD	gull_tern	Least tern	Sterna antillarum			G4	11996	HIGH
BIRD	gull_tern	Least tern	Sterna antillarum			G4	11996	HIGH
BIRD	gull_tern	Common tern	Sterna hirundo			G5	11996	HIGH
BIRD	waterfowl	Common moorhen	Gallinula chloropus			G5	51996	HIGH
BIRD	wading	King rail	Rallus elegans	S	T	G4G5	11996	HIGH
BIRD	wading	Least bittern	Ixobrychus exilis	S	E	G5	51996	HIGH
BIRD	shorebird	Piping plover	Charadrius melodus	S/F	T/T	G3	11996	>=5
BIRD	shorebird	Piping plover	Charadrius melodus	S/F	T/T	G3	11996	>=5
BIRD	shorebird	Piping plover	Charadrius melodus	S/F	T/T	G3	11996	>=5
							0	
BIRD	gull_tern	Great black-backed gull	Larus marinus			G5	71996	-
BIRD	wading	Black-crowned night-heron	Nycticorax nycticorax			G5	71996	-
BIRD	gull_tern	Herring gull	Larus argentatus			G5	71996	-

biofile.dbf

Element	Subelement	Name	Gen_spec	S_f	T_e	Nhp	Date_pub	Conc
BIRD	waterfowl	Common moorhen	Gallinula chloropus			G5	51996	HIGH
BIRD	wading	King rail	Rallus elegans	S	T	G4G5	11996	HIGH
BIRD	wading	Least bittern	Ixobrychus exilis	S	E	G5	51996	HIGH
BIRD	shorebird	Piping plover	Charadrius melodus	S/F	T/T	G3	11996	>=5
BIRD	shorebird	Piping plover	Charadrius melodus	S/F	T/T	G3	11996	>=5

In the ***biofile*** table, the columns **S_f** and **T_e** indicate whether the species is listed as threatened (T) or endangered (E) on either the state (S) and\or federal (F) lists.

Note: the order of codes for threatened (T) and endangered (E) refer to whether the species is listed as a state (S) or federal (F) species. For example, the code T/E indicates that a species is identified as threatened for the state but endangered for federal listings.

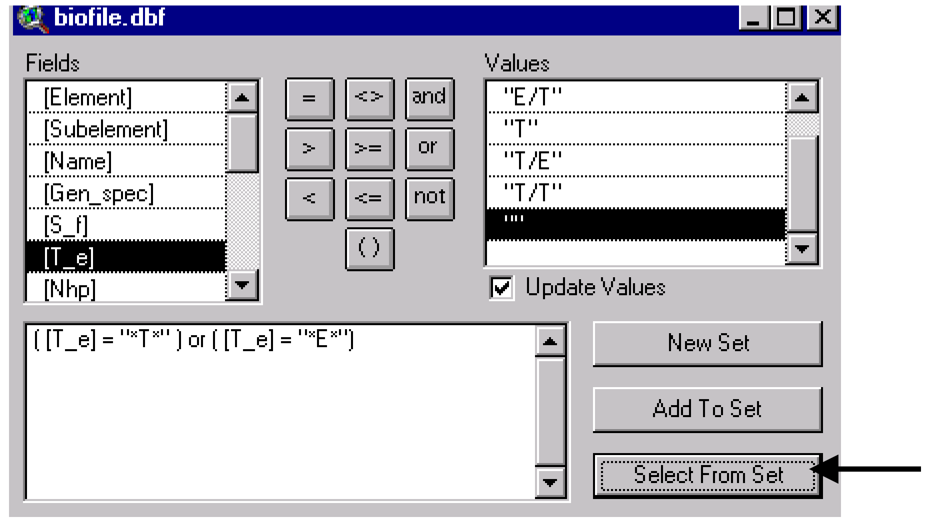
The column **Conc** provides an estimate of the concentration of each species at the site. For the bird data, concentration is indicated as "VERY HIGH", "HIGH", "MED", "LOW", or as a numerical value representing the number of individuals occurring in a polygon. The descriptive concentration estimates are subjective, based on local expert opinion of relative concentrations in the area. The numerical concentration values are based on survey data which may fluctuate seasonally and annually based on local or regional conditions at any particular site.

The species seasonality is shown in the next twelve columns representing the months of the year. If the species is present at that location in a particular month, an "X" is placed in the month column.

The **Breed** columns in the data tables include the months when reproductive activities occur or early life stages are present.

Also associated with each biological polygon on the map is a resources at risk identification number (**Rarnum**). The Rarnum is used as a reference to identify a species found in a specific polygon.

Now that bird polygons have been selected within the ACEC, we can use the ***biofile*** table to determine if any of these species are threatened or endangered.



From the **Table** menu choose **Query**.

From the **Fields** list double click on **T_e** and click once on the “=“ button.

Now type the expression **“ *T* ”** (include both quotes and asterisks). This will include all species *threatened* either federally or in Massachusetts.

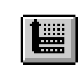
Click once on the **OR** button.

From the Fields list double click again on **T_e** and click once on the = button.

Then **type** the expression **“ *E* ”**. This will include all species *endangered* either federally or in Massachusetts.

Finally, choose **Select from Set**. This will select out all threatened birds from the polygons within the ACEC.

Close the **Query** dialogue box.

With the **biofile** table still active, click the **Promote** button to move the selected records to the top of the table. 

biofile.dbf

Element	Subelement	Name	Gen_spec	S_	T_e	Nhp	Date_pub	Conc
BIRD	wading	American bittern	Botaurus lentiginosus	S	E	G4	51996	HIGH
BIRD	diving	Pied-billed grebe	Podilymbus podiceps	S	E	G5	51996	HIGH
BIRD	raptor	Bald eagle	Haliaeetus leucocephalus	S/F	E/T	G4	111997	-
BIRD	wading	King rail	Rallus elegans	S	T	G4G5	11996	HIGH
BIRD	wading	Least bittern	Ixobrychus exilis	S	E	G5	51996	HIGH
BIRD	shorebird	Piping plover	Charadrius melodus	S/F	T/T	G3	11996	>=5
BIRD	shorebird	Piping plover	Charadrius melodus	S/F	T/T	G3	11996	>=5
BIRD	shorebird	Piping plover	Charadrius melodus	S/F	T/T	G3	11996	>=5
BIRD	shorebird	Semipalmated sandpiper	Calidris pusilla			G5	71996	HIGH
BIRD	waterfowl	American black duck	Anas rubripes			G4	71996	HIGH

The selected records show Threatened or Endangered birds in the ACEC.

Now make the **Sources** table active and click the **Promote** button. 

The selected record identifies who contributed this information about these bird records, how the data was obtained, and what year the records are from.

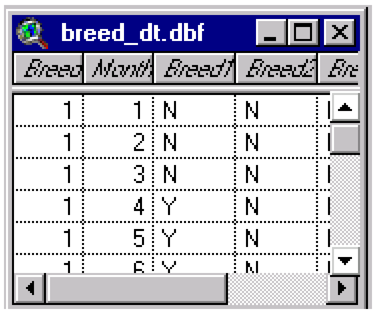
sources.dbf

Source_id	Originator
34	DFWELE, DFW
1	RESOURCE MGT. PROJECT
2	PUBLIC ACCESS BOARD, DF
3	HAIN, J., NMFS/NEFSC (PRIN
4	HAIN, J.H.W., ET AL
5	WARING, G.T. ET AL
6	BURBELL, D., DFWELE/DFW

Turn off the **Birds** theme before moving on.

Exercise 5C. Explanation of ESI tables and human use resource data

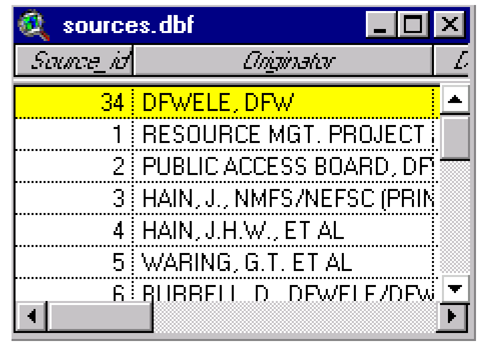
In addition to the **biofile** table, the three other linked data tables contain useful information. A description of each is provided below.



breed_dt.dbf

Breed	Month	Breed1	Breed2	Bre
1	1	N	N	
1	2	N	N	
1	3	N	N	
1	4	Y	N	
1	5	Y	N	
1	6	Y	N	

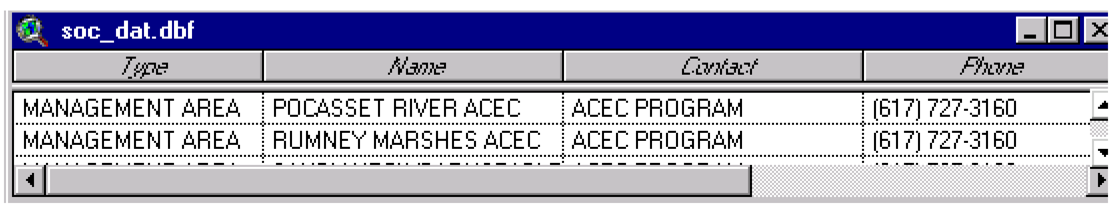
The ***breed*** table identifies when reproductive activities are occurring during months 1-12.



sources.dbf

Source_id	Originator
34	DFWELE, DFW
1	RESOURCE MGT. PROJECT
2	PUBLIC ACCESS BOARD, DF
3	HAIN, J., NMFS/NEFSC (PRIN
4	HAIN, J.H.W., ET AL
5	WARING, G.T. ET AL
6	BURBELL, D., DFWELE/DFW

The ***sources*** table contains a list of sources who contributed the ESI information.



soc_dat.dbf

Type	Name	Contact	Phone
MANAGEMENT AREA	POCASSET RIVER ACEC	ACEC PROGRAM	(617) 727-3160
MANAGEMENT AREA	RUMNEY MARSHES ACEC	ACEC PROGRAM	(617) 727-3160

The ***soc_dat*** table provides background on the specific type of human use resource and contact information.

Make the **View** active again and turn on the **soceconp** theme. From the **Theme** menu, choose **Hide/Show Legend**. Zoom into different parts of the view to observe locations of ESI human use resource data such as boat ramps, commercial fishing, marinas, and water intakes.

Human-use resources are point features indicated by a black-and-white icon.

Massachusetts human-use resources can be divided into three major components:

1) High-use recreational and shoreline access locations including recreational beaches, sport-fishing, and diving areas. Boat ramps and marinas are shown both as recreational sites and access points for response activities.

2) Officially designated management areas including national parks, state and regional parks, Indian reservations, marine sanctuaries, national wildlife refuges, and preserves and reserves set aside by various agencies and organizations.

3) Resource extraction locations including aquaculture, commercial and subsistence fisheries, mining lease sites, and water intakes. Each of these sites has a unique problem or issue that can significantly complicate oil removal strategies.

For more information on the ESI project and data, consult the metadata file located on the Great Marsh GIS CDROM located in the **/esi/metadata** directory or contact MassGIS.

END